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Agriculture

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CONTENTS

Total Solids in Milk

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Under the Milk Marketing Board's new proposals for payment according to the compositional quality of milk, the percentage of total solids (fat and s.n.f.) becomes very important.

The factors affecting the fat content of cows' milk have been the subject of a considerable amount of research work. But less has been done on those affecting the solids-not-fat (s.n.f.) content, and comparatively few projects have been planned in which the primary object has been to investigate total solids as such. However, since the total solids percentage is merely the sum of fat percentage and s.n.f. percentage, studies involving the determination of these two values separately can also be valuable in studying the factors affecting total solids percentage. It is, in fact, very useful from the practical point of view to study the changes in fat percentage and s.n.f. percentage separately. Although the two usually tend to move up or down together, they may in some circumstances move in opposite directions.

The causes of variation in total solids percentage may conveniently be considered under two headings—those which are inherent in the animal and those which are due to environment, including the feeding and management of the cows concerned.

Inherent factors

The more important causes of variation under this heading are breed, age, individuality, and the stage of lactation.

The mean total solids percentage for the individual breeds varies from about 14·1 per cent for Jerseys to about 12·3 per cent for Friesians. This range includes nearly all the other breeds used for milk production in this country. But it should be borne in mind that these are overall breed averages; within the breed herds vary to some degree and cows within herds vary greatly. It is also worth bearing in mind that the differences between breeds in total solids percentage is usually due to a much greater extent to differences in fat percentage than in s.n.f. percentage. For example, of the 1·8 per cent difference between Friesians and Jerseys, 1·3 to 1·4 per cent is due to differences in fat percentage.

Most of the bigger surveys of the effect of age (in lactations) on milk quality have indicated that, on average, the s.n.f. percentage falls by about 0·3 per cent from first to fifth lactation. There is often a small reduction in the mean fat percentage, but this varies a good deal from herd to herd. For purposes of planning it might be assumed that the decrease in fat percentage from first to fifth lactation might be about 0·1 per cent. On this basis the decrease in total solids percentage from first to fifth lactation would be 0·4.

In individual animals of the same breed there is a wide range in the level of total solids. Some examples of the range in lactation mean total solids for Friesians in batches of the same age at the same farm and in the same season are shown in the table which follows.

	Lactation mean total solids percentage Highest	Lowest	Range
40 Purchased heifers—various sources	13·83	10·78	3·05
17 Home-bred heifers	13·94	11·95	1·99
19 Home-bred-second calf cows	13·80	12·11	1·69

Even with half-sisters, i.e., the progeny of a particular bull, when these are kept under similar conditions at a progeny testing station the difference between the highest and lowest heifer is frequently of the order of 1·5 per cent total solids and sometimes more than 2·0 per cent total solids. Thus the potential to produce a high or low total solids percentage which is inherent in the individual animal is of considerable importance and, of course, makes possible improvement in a herd by culling.

Both the s.n.f. and fat content of milk are usually at the highest levels after calving as the change takes place from colostrum to normal milk. During the first week or two both components fall rapidly and, with uniform rationing, reach their lowest levels a little later than the peak milk yield—usually about one to two months after calving. With older cows, the lowest fat levels may come at a somewhat later stage in lactation. From the lowest levels a few weeks after calving the s.n.f. percentage will, with adequate feeding, trend very slowly upwards as lactation advances, The fat percentage usually rises a little more quickly. These within-lactation differences in fat percentage and s.n.f.percentage are substantial and, since they tend to coincide, the difference in percentage total solids at, say, 2 months after calving compared with 7 months after calving, might be as much as 1·0 per cent or even 1·5 per cent total solids. However, the within-lactation variation is perhaps not of much importance in herd management since, where calvings are spread through the year, the effects on the herd bulk milk will usually be small and in any case they cannot be avoided. The case may arise, however, where a heavy concentration of calving over a short period may result in difficulties a few weeks later if penalties for low milk composition are based on short periods.

Feeding, a major factor

There can be no doubt that the major environmental factor affecting the total solids percentage in milk is feeding. Unfortunately, the effects of feeding on milk composition are complex and it is not possible to define with certainty the practical implication of some of the results obtained in experiments. There are, however, two general conclusions which are of particular importance. The first is that the plane of energy or starch equivalent intake may affect not only milk yield but also milk composition. The second is that where feed changes result in changes in the type of fermentation in the rumen, this may result in a change in the fat percentage or s.n.f. percentage, or both.

In experiments planned to study the relationship between starch equivalent intake and s.n.f. percentage, responses have varied. Where the rations compared were at or above the usual (Woodman) standards, differences in s.n.f. percentage were often small. Where, however, rations on the standard were compared with those supplying only 70 or 80 per cent of the estimated starch equivalent requirement, differences in s.n.f. percentage have often amounted to 0·2 or 0·3 per cent and, in exceptional cases, as much as 0·5 or 0·6 per cent s.n.f. The effect of plane of energy intake also depends on the

length of the experiment, and a reduction in starch equivalent intake over a long period tends to have a greater effect on s.n.f. level than a temporary reduction of the same magnitude.

The effect of plane of energy intake on fat percentage is not so clear cut. There are a number of experiments which indicate that a sustained high plane of energy intake will result in milk with a somewhat higher fat content than a sustained low plane of energy intake. On the other hand, where the level of feeding is decreased it sometimes happens that the yield and s.n.f. percentage may fall while the fat percentage may, for a time at least, increase.

The composition of milk seems to be influenced not only by the current level of feeding but, to some extent, also by previous nutrition. There is evidence that a low plane of nutrition in the last few weeks before calving may substantially reduce both the fat percentage and s.n.f. percentage during the first few weeks of lactation, even when the animals are fed at recommended standards after calving.

It is known from rumen infusion experiments that acetic acid and butyric acid may result in an increase in fat percentage in milk, while propionic acid and lactic acid may increase the s.n.f. percentage. It may reasonably be assumed that practical rations which result in fermentations favouring the production of any one of these fatty acids preferentially would result in an increase in the appropriate fraction of the milk solids. Unfortunately, the direction of the fermentation by feeding changes requires a good deal more study before it can be fully exploited. There is, however, evidence that rations containing too little roughage—e.g., heavy concentrate feeding in winter or liberal feeding of very young grass in spring, may result in a dramatic decline in the fat percentage, with little or no compensatory rise in the s.n.f. percentage. The same effect can be produced with larger quantities of hay if this is fed in a fine state of division. There are, therefore, practical measures that can sometimes be taken to prevent a poor rumen fermentation so far as fat synthesis is concerned.

Udder health

Mastitis infections may reduce not only milk yield but the fat and s.n.f. percentages also. The depression in the composition depends on the type, severity and duration of the infection and on the measures taken to control it. In one investigation in which the infections were mainly due to *Staphylococcus pyogenes*, and where cows with mastitis were treated with antibiotic until cured, the mean depression in s.n.f. percentage of the individual cow during infection was estimated at about 0·2 per cent. A depression in fat percentage of a similar order was also obtained, so that during the period of infection the mean total solids percentage depression for the individual cow was about 0·4 per cent. It seems, however, that following spontaneous recovery, or recovery due to treatment, the fat and s.n.f. content trends towards the pre-infection level and normally reaches this level in the next lactation. A fairly heavy infection in a herd would usually be required to produce a marked depression in the total solids of the herd bulk milk.

Milking

Both the length of the periods between milking and the efficiency of the actual milking can have a very pronounced effect on the fat content of milk.

This is because the last-drawn milk is very rich in fat, sometimes as high as 12 or 14 per cent, and the proportion of the last-drawn milk to the main flow may materially affect the percentage for the whole milking. The effect on s.n.f. percentage seems, however, to stem mainly from the indirect influence of the higher or lower fat percentage in milk and, in practice, changing the period between milkings or milking method is unlikely to have a great effect on the s.n.f. percentage. Thus milking efficiency may have an effect on total solids percentage but this is mainly through the fat percentage.

Herd management

From the above summary it is clear that there are several effective ways of increasing the total solids in the bulk milk of the herd. Unfortunately, most of these involve extra cost, and the problem of raising the level economically is much more difficult.

The two most effective means of improving the total solids percentage of the bulk milk of the herd will be (*a*) culling of individual cows normally producing milk low in total solids percentage, (*b*) changing the feeding of the herd. Before adopting either of these methods, however, the herd owner might well be advised to find out the incidence of mastitis in his herd. This would require veterinary help, but reduction of the incidence might be economic on grounds of improved milk yield alone. It would also be wise to check the milking technique. Improvements here would probably not involve much extra cost and again might bring about an improvement in yield.

Culling

There is little published information on the effect of culling on the total solids percentage of herd milk, mainly because of lack of information about the s.n.f. percentage for individual cows. The effectiveness of culling obviously depends on the variability among members of the herd. Some idea of the scope may perhaps be gleaned from the following two herds.

The first (Herd A) consisted of 41 Friesians, all in their first lactation, and the data refer to accurate determinations of fat percentage and s.n.f. percentage for each animal over the first 7 months of lactation. In this case the heifers came from several sources and would be somewhat more variable than normal, although lacking variation due to age. The second (Herd B) refers to data on a herd of 60 Friesians for one year at the N.I.R.D. In this case the age distribution was about the same as for the national herd, but nearly all the animals were home bred; many were sired by the same two or three sires. The unweighted herd average for total solids has been determined for (*a*) the whole herd, (*b*) the herd with 10 per cent lowest animals culled, (*c*) with 20 per cent lowest culled, (*d*) with 10 per cent lowest culled and replaced with Channel Island heifers at 14·0 per cent total solids (assumed to be yielding the same amount of milk as the culled animals). The mean total solids percentage of the herd bulk would be approximately as follows:

Herd	Original herd mean	10% lowest culled	20% lowest culled	10% lowest replaced with Channel Island at 14% t.s.
A	12·23	12·35	12·44	12·51
B	12·65	12·73	12·79	12·86

It is of interest that in Herd B the removal of the six oldest cows (10 per cent of the herd) irrespective of their milk quality raised the total solids percentage from 12·65 to 12·69 only. This involved removing animals varying from 6th to 10th lactations. In herds with more older cows or where a high incidence of mastitis has been experienced, a greater improvement might be expected, but it is clear that culling "blind" on age alone may be much less effective than culling with the data for individual animals available.

To the practical man, culling may seem to be a very inefficient way of improving the total solids percentage of herd milk and, indeed, where this involves the sale of high-yielding cows it may often be uneconomic. It must also be remembered that the improvement indicated in the cases cited will normally be smaller in the next lactation, since there is always a tendency for a low or high cow to trend towards the average in the next lactation. Two points should, however, be borne in mind. The first is that the effect of culling will be long-term, persisting as long as the residue of the cattle remain in the herd. Secondly, circumstances may arise in future where a marginal increase may put the herd milk into a higher compositional price category, and quick effective means of making this small advance may be merited.

Possibilities of increased S.E.

For many dairy farmers the attempt to increase the total solids percentage of the herd milk will probably be made by way of improved feeding. This will often mean rather higher feeding costs, and the economics of such a change will depend on whether (*a*) this brings about a concomitant increase in milk yield and (*b*) it puts the milk into a higher compositional price category. Probably the most promising line of action on many farms would be to raise the starch equivalent intake of the cows involved, either by improving the quality of the bulk foods used or by increasing concentrate usage. Unfortunately it is not possible to generalize on the effect of these procedures on milk yield on the one hand and total solids on the other. In short-term experiments an additional 1 lb of starch equivalent to rations supplying energy at about the normally recommended standards will often result in the production of about an extra 1 lb of milk. But an estimate of the response from 1 lb S.E. in terms of increased total solids percentage would be difficult to make. The response in cows already receiving the recommended standards would often be small, and this probably accounts for some of the disappointment when the feeding of additional cereals fails to bring an appreciable increase in total solids levels.

A much greater response to additional concentrates can sometimes be obtained, particularly in the s.n.f. fraction where the cattle are otherwise on a low plane of nutrition. This low plane may take the form of simple underfeeding or making available ample feed but of a quality and palatability which discourages the cow from eating enough to cover her requirements. Thus, for example, in short-term experiments with *ad lib.* silage feeding where energy intake falls short of requirement, cereals may sometimes give responses of about 1 lb milk per lb additional starch equivalent and at the same time increase s.n.f. by 0·05 per cent per lb additional S.E.

In considering the energy intake of the herd, it is wise to plan on a lactation basis and to attempt to prevent an abnormal fall in total solids rather than to be left with the problem of rectification after a slump has taken place.

Concentrates fed for steaming up may be of considerably greater importance if they result in removing the milk in the subsequent lactation into a higher compositional category.

Type of feed

Improvement in total solids by changes in the *type* of feed is likely to be difficult until more is known about the effect of rumen fermentations on milk quality. There is a danger that changes aimed at improving fat percentage may adversely affect s.n.f. percentage and vice versa, so that the resultant benefit to total solids percentage could be very small or non-existent. For example, while the addition of flaked maize seems in some circumstances to improve s.n.f. percentage, it could, in the absence of adequate fibre in the ration, cause a decline in fat percentage. Similarly, an over-liberal proportion of fibrous feeds may maintain a good fat percentage, but where it brings about a restriction in supply of soluble carbohydrates and other good sources of energy, it may reduce the s.n.f. percentage.

There are, however, particular circumstances where the type of feed may be adjusted with good prospect of improving the total solids content. Perhaps one of the commonest opportunities occurs when cows go on lush young grass in the spring. A typical result of this is an increase in milk yield, an increase in s.n.f. percentage and a decrease in fat percentage. By retaining a small portion of the winter hay ration for the first 2 or 3 weeks at grass, it is sometimes possible to achieve the beneficial effect of grass on yield and s.n.f. while at the same time retaining a good fat percentage.

Opinions will undoubtedly vary as to the methods of dealing with the problem of the total solids content of herd milk. The conclusions drawn from this brief appraisal are, first, check the udder health and efficiency of milking and machine stripping, second, check the feeding regime, particularly the long-term level of energy supply, and third, if the data on individual animals are available, carry forward a culling plan. Before changing the feeding or before culling, the effect on the market value of the herd milk in relation to the cost of the operation should be calculated so far as both quantity and quality are concerned to try to find out if the changes are likely to yield a financial advantage.

Work Study in Horticulture

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Horticultural work study is still in its infancy in Britain but, as Mr. Mitchell shows, ten years' application at Fernhurst has undoubtedly increased efficiency all round, and there is no reason why work study should not become accepted throughout horticulture as an indispensible part of good management.

WE started work study at Fernhurst as long ago as 1951, at which time there was very little experience in this field in Britain. Fundamentally the object of work study is to facilitate good management, and ten years' experience and its application here has certainly increased efficiency all round. Fernhurst, Plant Protection's experimental station near Haslemere in Surrey, is an estate of 420 acres. This area is divided into commercial growing sections of 230 acres; trials fields 40 acres; gardens and amenity land of about 20 acres. The remainder is rough grazing and woodland. There are packing facilities to serve vegetable and flower production and, attached to the orchards section, an apple store and grading room.

Work study uses two main interdependent techniques—method study and work measurement. Method study provides a picture of events which can be analysed to improve work methods. Work measurement gives quantitative information which can be used as a basis for correct manning, effective planning, labour costing, continuous economy of manpower and financial incentive schemes.

Work study at Fernhurst

Normally method study should precede work measurement, to ensure not only that the correct work methods are operating but to see whether the work ought to be done at all. It soon became apparent at Fernhurst that because few jobs continue for more than a few weeks, and the cost of most of them is fairly low, it is economic to apply formal method study only to new projects or jobs which are costly or time-consuming. The cost factor is not usually very significant, since speeding up a job will usually have only a small effect in terms of absolute cost. The timeliness of operations, however, is very important, for anything which will enable management to do work when it needs to be done produces a considerable gain, although it is often difficult to make a realistic cost return comparison.

For these reasons it was decided that the main emphasis should be placed on work measurement, and incentive schemes operated as soon as possible. To gain the immediate effect of the incentive, the following procedure was adopted. Time studies were made of an operation as it was originally being done. After the initial study, obvious defects in the methods used were pointed out and discussed with the foremen and men. Frequently an examination of the recorded elements showed advantages to be gained from eliminating, combining or rearranging them. The job was then reorganized at this level of detail and further studies were made. An allowed time was

issued for the job, and a bonus paid on a job basis. Sometimes it was apparent that a further, more formal, method study was needed, particularly where there was a conflict between methods and growing techniques. In such a case, the job would be recorded for analysis and examination at a later date.

This procedure produced the following categories of information:

1. Where the method was adequate, an allowed time for the job and a job specification was drawn up. Bonus was paid immediately on performence of the job as measured, and the time accepted as standard until there was any change in work specification.

2. Where the method needed revision later, an allowed time was issued for the method as studied and it was stipulated that the time applied for that occasion only.

3. Where, although the method needed no revision, the work content could not be predicted (e.g., carnation disbudding, hand hoeing, etc.), the value was issued for that occasion only, and during the course of several seasons data was built up to enable the significant variables to be isolated and analysed to arrive at a standard time for the job. This third category includes disbudding carnations, the later stages of tomato training, hand hoeing and singling, pruning and certain harvesting jobs.

For all these jobs standard times are available at a very fine level of detail, but it is still difficult to predict accurately what conditions will be at the start of a job. A sample of the work to be done will indicate the range within which the time will fall, but it is our present practice to measure the work as the sample is being taken. This not only safeguards the worker by confirming that the build-up of detail is correct, but also helps in the ultimate classification of the work content.

As an example, hand hoeing has been studied for several years. It has been possible to isolate five main variables which affect the work content: soil condition, weed intensity, weed height, plant diameter and plant height. Subdividing each of these variables into three or four categories, we arrive at over 600 possible combinations. After eliminating the unusual or unlikely, we are still left with over 100 variables. When studies are analysed into these categories, the cover on some of them is pretty thin. We have a range of values from 0·28 to 1·46 per foot of bed, and although from experience we can assess the conditions and forecast the approximate work content, it has so far been impossible to produce a readily identifiable and calculable value. It is essential to have a formula, so that the men doing the work can check on the calculation of the work content under different conditions.

As a result of this three-pronged application of incentives, some 60 per cent of jobs are now covered by standard times, 20 per cent are still studied as they occur, and the remainder are either considered not economically suitable for measurement or it is management policy to avoid incentives where no safeguards can ensure quality performance.

Uses of work measurement data

Bonus is calculated on the operator unit hour. This is an index of performance obtained by totalling the units of work done by a worker and dividing by the hours taken to accomplish them. If, for example, the allowed time for disbudding a chrysanthemum is 0·80 minutes and the worker disbuds 900 plants in 10 hours, the index of performance is $\frac{0{\cdot}80 \times 900}{10} = 72$.

Earnings on that job are the hourly job rate $\times \frac{72}{60}$, and bonus earned is the difference between actual earnings and hourly rate.

Because all ages and both sexes do the same work, and rates of pay vary from 1*s*. 6*d*. to 4*s*. 2*d*. an hour, bonus is calculated not on individual job rates but on the average job rate for people in a section. The workers accept this. For certain jobs where conditions may vary, the performance reward basis is altered slightly so that where conditions are difficult the reward is greater and where they are easier the reward is less than the index would show. In addition, on jobs where it is difficult to check quality of performances a limit is placed on the amount of bonus which can be earned.

Using the work measurement information at our disposal, it is now possible to draw up a comprehensive plan for the year's operations in each section. Work programmes and weekly labour requirements can be planned with sufficient accuracy, and it is possible to achieve close integration of the work of the five major productive sections. Cropping plans have to some extent been tailored to fit complementary labour requirements so that work is fairly evenly spread among the sections. For example, market garden and orchard labour requirements are dovetailed. Peaks at pruning and apple picking occur at a time of low market garden labour needs, and spring and autumn planting peaks in the market garden can be reduced by transferring orchard workers.

Targets have nearly always been met despite adverse weather conditions. Progress is reviewed at least weekly and action taken in good time to achieve target dates. There is also the psychological factor of having an aiming point.

Packing shed operations are governed by the plans of producing departments, and potential throughput can be gauged when work programmes for producer sections have been completed. The packing shed work load becomes readily apparent and action can be taken in good time to avoid bottlenecks at the marketing stage.

A simple labour costing system is operated. Its object is to give a yardstick of efficiency, and because most work is performed under incentive conditions, standard costs can be calculated and deviations from them are quickly apparent. This is important if costing is to mean anything. Historical costing is better than none, but too often the delay between event and costing obscures the real reason for cost variations, and there is no standard for comparison. There is little merit in comparing one year's costs with another if there is no clear record of what work is represented. Work measurement provides the necessary facts and makes it easy to see the cost of individual operations. It distinguishes between cost variations caused by changes in methods or efficiency in any operation and effects caused by additional operations.

Other aspects of labour costing are the ability to establish a unit cost to decide at what stage to discontinue marketing or to change from one type of container to another, to establish optimum combinations of crops bearing in mind conflicting labour requirements, and to compare variations of work content within a crop.

Correct manning is closely related to planning, but operates at a much finer level of detail. Work measurement information indicates correct team balance within a job. Uneven sharing of the work among a team not only slows down the job but irritates workers who are overworked while others

are under-occupied. Incorrect team balance is a major cause of low productivity.

Indices of individual work performance show the effect of poor job organization, changes in conditions under which the work is performed, and the employees' suitability for various types of work. These indices act as a pulse.

Some results at Fernhurst

There is little doubt that work study has made a considerable contribution towards efficient management. The planning and manning of cropping, work incentives and the costing of crops are now fully integrated aspects of management, and this has led to a more contented labour force and improved timeliness of operations.

In 1952 the permanent labour force of the market garden, Dutch lights, glasshouse and packing shed was 44. In 1961 it was 35. In 1952 returns from these sections were £42,000. In 1961 (not a particularly easy year because of a very wet spring and preceding autumn) returns were £58,000.

It is difficult to make comparisons over a period of years because of wage and price movements. A reasonable index is labour cost per £1,000 of sales. Labour cost has been adjusted to the rate ruling in 1957, but returns are actual, since seasonal variations far outweigh any inflationary price tendency.

Labour cost per £1,000 of sales

1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
444	426	405	375	316	295	299	251	277	258

The apparent upturn in the last two years is misleading: 1959 was an excellent growing year, when sales increased to a very high point with a resultant fall in the proportion of labour cost to sales. If 1959 is ignored, the downward trend is fairly uniform, even though 1960 was a terribly difficult year.

During these years, average earnings have increased from 2*s*. 4*d*. to 5*s*. 2*d*. per hour, and labour costs in absolute terms per £1,000 of sales have fallen by about 5 per cent. In other words, increased labour costs have been more than counterbalanced by increased productivity.

As far as labour costs on individual crops are concerned, the glasshouse unit probably gives the best indication, since the effect of seasonal environmental changes is reduced to a minimum.

In 1956, 10,750 hours at a cost of £1,603 produced tomato sales of £13,414. In 1960, 9,465 hours at a cost of £1,893 produced sales of £16,000. This means that while earnings increased by 25 per cent, cost per £1,000 of sales was unaffected.

Mid-season chrysanthemums are another example. In 1956, 6,555 hours at a cost of £960 produced 8,317 dozen blooms. In 1960, 5,643 hours at a cost of £1,130 produced 8,920 dozen blooms. This means that hours per dozen blooms fell from 0·79 to 0·63 (20 per cent). Labour costs per dozen blooms increased from 2*s*. 4*d*. to 2*s*. 6*d*., while earnings per hour increased from 2*s*. 11*d*. to 4*s*. Because of fixed costs, the actual cost per dozen blooms fell by 6 per cent and total profit increased by 10 per cent.

Similar increases in productivity have occurred in other enterprises, but it is more difficult to make direct comparisons because of price variations and weather effects on yields. However, the following comparisons can be made.

	Reduction in hours *per cent*	Reduction in cost *per cent*
Cabbage planting	44	27
Leek hoeing	44	27
Double digging	48	25
Gladioli planting	60	43
Chrysanthemum crop	50	28
Tomato picking	40	20
Steam sterilizing	65	57

It must be emphasized that growing techniques have improved, and that rationalization and maximization of cropping have contributed considerably towards this increased productivity, but work study techniques and information have also influenced cultural techniques, in addition to their direct contribution to more efficient working.

Wider application of work study

What has been achieved at Fernhurst can be done elsewhere. Work study applications can reasonably be expected to reduce labour costs by over 10 per cent. If it is considered that the application of these techniques by a qualified person would cost £1,000 per year, then any enterprise with a wage bill exceeding £10,000 can afford to employ a work study specialist.

Enterprises in close proximity may share a work study man, particularly if they are producing similar crops. Regions such as the Lea Valley, the Worthing area, Guernsey, the Blackpool area and the Vale of Evesham have great possibilities for this sort of co-operation, and there are many other localities which could benefit similarly. Smaller, more scattered growers will be able to call in the services of the N.A.A.S.

Horticultural work study in Britain is still in its infancy. Fernhurst took the initial step ten years ago and events have fully justified it. There is no reason why work study should not become accepted throughout horticulture as an indispensible part of good management.

Hybrid Vigour in Pigs

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What is the commercial value of hybrid vigour in pig husbandry? The results of some recent trials with cross-bred pigs are discussed.

FOR the producers of commercial livestock, cross-breeding is an established practice. It has been used to introduce a new character such as lack of horns in cattle and to take advantage of the phenomenon of hybrid vigour. The practice continues to be very popular with pig producers, and in evidence of this we don't need to look further than the universal respect for the "blue and white" pig. Eighty-five per cent of the pigs marketed in the United States are cross-bred. Of the two possible benefits of cross-breeding, the production of hybrid vigour (or heterosis) is perhaps the more important reason for its general use in pig production.

Hybrid vigour has been defined as the superiority of the cross-bred progeny over the better parent. This definition may be valid where superiority can be measured by one character alone but, in the case of the pig, superiority needs to be measured through a *number* of factors, such as litter numbers, weights at birth and at weaning, food conversion rate, liveweight gain per day and carcass measurements. Consequently a more realistic measure of hybrid vigour is given when the production factors of the cross-bred pig are compared with the performance of a non-existent composite parent.

American research workers have shown that where cross-bred litters were compared with the pure-bred litters of both the pure breeds used in the cross, the cross-bred litters at birth were intermediate in number to those from the parental breeds. They also found that a greater percentage of the cross-bred pigs survived. Similarly, mean pig weight at birth of the cross-bred litters was intermediate to that of the parental breeds, but at weaning the mean weight of the cross-bred pigs surpassed the parental average by 8–10 per cent. In feed efficiency, the cross-bred pigs were from 3 to 4 per cent superior to the parental average.

Although the number of litters from which these figures were taken are relatively small, the comparative results seem to agree favourably with records obtained from commercial production.

Trials on Experimental Husbandry Farms

Trials carried out at Terrington and Trawscoed Experimental Husbandry Farms have given results which tend to agree with those from American trials. At Terrington, crosses between the Large White and the Essex have been compared with pigs of both pure breeds; at Trawscoed crosses were made between the Large White and Welsh breeds.

At each centre a pure-bred litter and a cross-bred litter were bred from each sow. In all, 24 sows and 6 boars of each breed were used during the trial. The individual sows and litters were kept confined during the suckling period, and all litters were weaned at 8 weeks of age.During the pre-weaning period,

the total litter weight and numbers at birth were recorded, the pigs were ear-marked and weighed individually at 3 weeks of age and at weaning.

Four test pigs were chosen from each litter and were those animals whose weights at weaning were closest to the litter average. After weaning, the complete litters were fed identically until the four test pigs in each litter reached an average weight of 60 lb. At this point the feeding part of the trial began and all pigs were fed according to live weight on standard meal rations.

The pigs were slaughtered at 200 lb live weight. Carcasses were weighed cold, and measured for length and depth. In addition, fat thickness was measured at shoulder, middle of back and loin. Thickness of streak was also measured. Although six batches of litters from three batches of sows and boars were tested at each centre, there was no great variation between them.

It is convenient to consider the performance of the pure-bred pigs and crosses under the three following headings:

1. Performance of litters up to weaning.
2. Liveweight gains and food conversion during the fattening period.
3. An assessment of carcass conformation.

Performance of litters up to weaning

There was considerable variation in the number of pigs born alive in the individual litters. However, at both centres the number of pigs born alive to cross-bred matings was slightly, but not significantly, higher than the pure-bred matings, namely, 2·7 per cent more at Terrington and 7·8 per cent more at Trawscoed.

At 3 weeks of age the average weight of the cross-bred pig was greater then that of the pure-bred at both centres, but in neither case was this difference significant.

At 8 weeks, the cross-bred pigs had also a slight advantage in weight over the pure-bred pigs at Terrington, but at Trawscoed there was no difference. When the total litter weight at 8 weeks is considered, the cross-bred litters outweighed the pure-bred litters by 29·4 lb at Terrington and by 25·5 lb at Trawscoed. These figures are equivalent to 12·1 per cent and 10·1 per cent respectively.

Even though these figures are not significant, they give the nearest approach to an indication of hybrid vigour found in the results during the pre-weaning period.

Performance during the fattening period

In daily liveweight gain for the period from birth to bacon, at both centres there was a slight advantage from the cross-bred matings. This was of the order of 4·9 per cent at Terrington and 2·1 per cent at Trawscoed, but in neither case was the increase statistically significant. These figures take into account not only any advantage gained during the feeding period itself, but also the slightly heavier weights of the cross-bred pigs at weaning.

Between 60 lb and 120 lb live weight, there was practically no difference in daily liveweight gain between both lots of pigs, but when feeding was continued up to bacon weight, there was an advantage in favour of the cross-bred pigs of 4·5 per cent at Terrington, but only 1·3 per cent at Trawscoed.

Meal conversion followed the same pattern as the liveweight gain during the fattening period—from 60 lb to 200 lb live weight.

Carcass conformation showed considerable variation within each group and no significant differences were obtained. Greater differences were obtained between pure breeds than between pure- and cross-bred pigs. In almost all respects the measurements for the cross-bred pigs fell intermediate between the measurements for the two pure breeds. It is therefore fair to assume that hybrid vigour had little effect on carcass conformation, as far as this could be assessed from the measurements taken.

Tendency towards better growth rate

Throughout the trial the performance of the individual litters varied considerably, and this variation tended to mask the effects of cross-breeding. For this reason no firm conclusion can be drawn, but in spite of this there was a general tendency for the growth rate of the cross-bred pigs to be higher than that of the pure breed.

The results obtained also tend to confirm previous trials carried out in America, although the improved food conversion was not so apparent in this series of trials.

Herbicides and Surface Reseeding

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Chemicals or machines? Are there any reliable and not too expensive short cuts to surface reseeding? With recent experiments in mind, Mr. Elliott examines this question.

IT is now five years since dalapon was first used in this country to kill an established pasture prior to reseeding. How far has this new and interesting technique progressed, and what place, if any, is it likely to find on our farms? Before considering the results of the many field experiments dispersed around the country, it is as well to outline their purpose. An essential prerequisite of all reseeding operations is that the old herbage should be so treated that it will not compete with the young seeds.

Traditionally the plough, and more recently the rotary cultivator, has been the means to this end: by mechanical movement and burial, the old sward is destroyed. With the very fast development of chemical herbicides in the past ten years, the question has arisen whether the death of the old sward might not be achieved better by chemicals than by mechanical movement. This revolutionary possibility has captured the interest of a number of official research and advisory organizations and, as a result, a considerable number of experiments have been carried out. Unfortunately no one organization has had sufficient research effort available to carry through a comprehensive and

co-ordinated programme of research on the performance of dalapon,* which is the centre-piece of most of the experiments.

As ploughing and reseeding is a well-established practice on lowland farms, the first approach to chemical destruction was to consider it as a means of reseeding difficult hill land or wet lowland where the plough cannot be used. To this end, many of the experiments have been concerned with killing the species that are found on such land, and of following up with light cultivations and reseeding. Few have been set up to study the effect of varying doses and time of spraying on plant response and the information about these two factors is therefore fragmentary. The most recent information is summarized in the table below:

Most susceptible:	Substantial kill obtained by 5–7 lb †acid equivalent per acre dalapon Moor mat grass (*Nardus stricta*), Flying bent (*Molinia caerulea*), Tussock grass (*Deschampsia caespitosa*), Heath rush (*Juncus squarrosus*), Sweet vernal (*Anthoxanthum adoratum*), False brome grass (*Brachypodium pinnatum*).		
Intermediate:	Fescues Bent grasses Meadow grasses	*Festuca* spp. *Agrostis* spp. *Poa* spp.	Contradictory evidence from different experiments
More resistant:	Dosages of 15 lb †acid equivalent per acre or more required for control Yorkshire fog (*Holcus lanatus*), Bog heather (*Erica tetralix*), the Sedges (*Carex* spp.), Bilberry (*Vaccinium Myrtillis*), Marsh Violet (*Viola palustris*), the Mosses (*Polytrichum Commune* and *Sphagnum* spp.), Heath bedstraw (*Galium saxatile*), Common tormentil (*Potentilla* erecta).		

It is becoming clear that seasonal time of spraying is an important factor governing the response of grasses to dalapon. For most species the toxicity of dalapon seems to be greater in late summer or autumn than in early summer[1,2]. One such species is Tussock grass; successful kills with autumn applications of 5–7 lb per acre dalapon have been achieved in successive years as far apart as Staffordshire and East Anglia, yet on two occasions 10 lb per acre of the chemical has failed to kill in May[3]. Bent grass (*Agrostis tenuis*) may be different; in an experiment carried out in south-east Scotland to test the effect of time of spraying, this grass was more susceptible to a May than to an August spray. These two species illustrate the difficulty of drawing conclusions about dalapon when many of the experiments involved spraying on a single date. What is now required is a comprehensive investigation of the effect of season on the response of different species, particularly the bents, fescues and meadow grasses.

Dalapon has limitations

It may be said on the credit side for dalapon that it can kill a large number of species that are very serious and widespread weeds on hill and wet land; this is a most valuable asset, and we must now learn to use it. But there is a reverse side of the coin. Dalapon at economic doses does not seem capable of producing absolute death; particularly is this so on lowland swards where

*Dalapon is the British Standards Institute name for 2,2-dichloropropionic acid. The chemical used in the experiments here considered was a proprietary product of the sodium salt containing a wetting agent.

†Commercial products contain 74 per cent acid equivalent.

bent grass, fescues and Yorkshire fog may be encountered[1]. In consequence there can be a danger of regenerating grasses competing with the new seeds. When this weakness is coupled with a slow rate of action (3-5 weeks for a complete effect) and appreciable persistence in the soil, dalapon becomes a difficult chemical to manage, particularly when spraying and reseeding are to take place in the summer. Many spraying experiments have been carried out on coarse surface mats or on acid peat where the surface conditions are quite unsuitable for the establishment of the new seeds.

It is now clear that herbicides alone cannot transform such material into suitable seedbeds, and it is therefore important to make a careful study of the soil conditions under the existing herbage before deciding on the method of reseeding. The trend of experience has indicated that success in surface reseeding with dalapon is most likely to be achieved where conditions approximate to those of a lowland permanent pasture and where dalapon is applied in the autumn and is followed in the spring by surface cultivations and reseeding.

At this stage a welcome must be extended to paraquat[4]. This chemical, 4,4-bipyridyl, at present being produced experimentally as the dimethyl-sulphate, has low mammalian toxicity and has no unusual handling difficulties. When used in 12 or more gallons of water at rates up to 3 lb per acre with a wetting agent, it is toxic to tufted and stoloniferous grasses. Foliage dies in 5–10 days, though longer is required for translocation into the root system. Paraquat does not persist long in the soil. Although there is very little published information, there are indications that creeping bent (*Agrostis stolonifera*) and Yorkshire fog (*Holcus lanatus*), neither of which is easily killed by dalapon, may be susceptible to paraquat[5]. Here then is a chemical with markedly different properties to dalapon and one which appears to be a most useful acquisition for the experimental work of killing swards. No doubt it will be well tested in the next few years.

At the outset of the experiments on sward destruction it was believed that so much was known about broad-leaved weeds such as buttercups and thistles that MCPA or 2,4-D need only be applied and death would result. Surprisingly, this has not been the case. Where these chemicals have been used in mixture with dalapon, they have not performed well[1,6]. Whether this may be due to an antagonism between the growth regulators and dalapon, or whether the growth regulators rely on grass competition to complete their work is not known, and must be a subject for further research. To get round this difficulty, amino-triazole has been tried with dalapon. This chemical is active against both grasses and broad-leaved plants but has unfortunately a high toxicity to white clover sown too soon after spraying. Much more experience of amino-triazole is required before a fair assessment can be made of its place in sward destruction.

Developing ideas

How far has this new technique progressed? The experimental work has been very valuable in clarifying the possibilities and the limitations of the chemical method. The strengths and weaknesses of the chemicals at present available are a useful guide to the properties that should be sought in those yet to be discovered. Many more chemicals with varied properties are required to deal with those pastures which at present appear difficult to kill. An apparent

weakness of the reseeding experiments has been that the seedbed cultivations have had, of necessity, to be limited to the few conventional implements which are readily available on farms. After death, the sward presents a surface unlike anything before encountered by agricultural implements and one which they were not designed to work. It may be that there will have to be implements designed to meet this new situation. The development of an entirely new technique for husbandry may be likened to the incoming tide of knowledge advancing over the shifting sands of our ignorance. The first rivulets creep forward, taking the line of least resistance and leaving behind them banks of higher sand which are eventually overcome by the weight of the incoming tide, till all arrive at the high water mark of success. Research on the use of herbicides for sward renovation has made some rivulets over the sand, but there are still plenty of banks waiting to be covered.

Parallel with the development of herbicides, there are a number of mechanical methods of renovation being investigated on run-down pastures. They vary from the substantial movement of soil and vegetation caused by rotary cultivations to the minimal disturbance of sod-seeding. Rotary cultivation involves the movement and chopping of the old herbage during seedbed preparation; this method usually leads to the fine seedbed which is desirable for the establishment of seeds, but it suffers from the weakness that the kill of the old herbage may be incomplete, and the new sward may be reinvaded.

If an uncritical standard of purity is acceptable, then the rotary cultivation appears to be a satisfactory method of reseeding on many fields, but a really pure stand of sown species will require the treatment of the sward with a herbicide prior to rotary cultivation. At the present time costs are against this combination. As sod-seeding involves little disturbance of the established herbage, the new seeds often suffer competition and are unable to establish themselves. In this situation it would seem essential to obtain at least a temporary suppression of the established grasses with a herbicide before sod-seeding.

Thus it may be that all these new methods of grassland improvement will become complementary rather than competitive, as they are at the moment. The best of each method may be amalgamated to provide a sound whole—for example, herbicides being used for sward destruction, which they undoubtedly will do better than machines in the long run, while surface-treating machines will create the seedbed which herbicides are powerless to achieve. What is important is that progress is being made towards providing farmers with more flexible methods of grassland improvement.

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(It is regretted that, for space reasons, other references supplied by the author have had to be omitted.—Editor.)

Can Bovine Mastitis be Controlled?

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The short answer to ridding our dairy herds of mastitis is hygiene.

OF all the diseases which have attacked our dairy cattle, mastitis stands out as the one which has been a constantly serious problem. Other diseases have been eradicated or controlled, but even with the advent of antibiotics, losses are still serious every year—loss of milk, loss of quarters, even loss of cows.

Admittedly, it seems paradoxical in these days of milk surpluses to worry that we are not getting enough milk from our cows, but we must produce our milk economically and that means getting more milk from less cows. Some farmers may have to turn to another, more profitable (for them), type of farming.

It is not that we haven't made any progress in the control of mastitis. To those of us who are closely concerned in the fight against this disease, the progress has appeared to be similar to walking up a "down" escalator. We have solved many problems, but as these have been solved new ones have appeared. The reason for this is not clear, but it seems reasonable to suppose that the increased yield which we have obtained from our cows has had to be bought at a price—and that price is increased susceptibility to disease because of the greater demands being put on the udder.

Wide incidence

We cannot compare the incidence of mastitis today with what it was before the war, because no accurate surveys were then carried out. The impression of those of us who were in practice in those days was that it did not appear to be such a great problem; but this could be wrong. It certainly seemed to be a simpler problem and by far the commonest form was mastitis due to *Str. agalactiae*. Today, thanks to the work of Stableforth and his co-workers at Weybridge, the solution to that particular problem has been found, but we are now coming up against other organisms responsible for mastitis and some of these have never been associated with this disease until recent times.

Although we cannot compare our position now with the days before antibiotics were used in the treatment of mastitis, we can draw some conclusions about the present incidence of mastitis from three surveys which have been carried out in the past few years. In the *National Survey of Disease and Wastage in the Dairy Herd, 1957-58,** it was claimed that the annual incidence of clinical mastitis was 10 per cent. Since this figure was based on layman diagnosis and data were collected only at very long intervals, this figure is likely to be a conservative one. The Milk Marketing Board, in collaboration with the National Institute for Research in Dairying, carried out a survey in 1957 in which once a month certain producers were asked by the

*H.M. Stationery Office. Price 4*s*. (by post 4*s*. 4*d*.)

milk recording officer how many cases of mastitis had occurred in the previous twenty-four hours. This survey found that on any one day 1 per cent of the milking cows would have some form of clinical mastitis, as evidenced by clots in the milk or other more obvious symptoms. This is an advance on the National Survey but it still relied on layman diagnosis. A more concentrated survey was carried out by the Ministry in all the herds within 10 miles of Reading in which each herd was visited once only, but in this case by a *veterinary surgeon* who examined the cows clinically as well as making a thorough examination of the milk samples. It was found that 5 per cent of the milks at *one milking* were so abnormal as to have been apparent to the careful inspection of a strip-cup by the cowman.

This then is probably a more realistic figure for the incidence of clinical mastitis in our dairy herds, but it must be appreciated that for every cow which is showing clinical symptoms there are probably five cows which are also infected with mastitis organisms and which are suffering from a sub-clinical form of the disease.

Sub-clinical danger

It is easy to recognize the loss in milk which results from an acute case of clinical mastitis, but what has not been recognized by farmers is that the disease in its sub-clinical state is still affecting the cows' milk yield. It has been shown by O'Donovan, Dodd and Neave (1960), that a cow with sub-clinical mastitis will lose 10 per cent of its anticipated yield in an infected lactation, and they used as their definition of sub-clinical mastitis the recovery of the same mastitis organisms from an infected quarter on a number of occasions with an associated increase in the cell content of the milk.

A recent examination of 1,500 churns of milk sent to a large collecting centre in London disclosed the alarming figure of 700,000 for the average cell content per ml. Compare this figure with the figure for normal milk of less than 250,000 ml, and it will be seen that sub-clinical mastitis is a serious problem in our herds today and one which demands a solution.

As has already been said, mastitis is a complex disease which can be due to a wide variety of organisms, but the sub-clinical form of mastitis is usually restricted to four species, namely *Str. agalactica*, *Str. dysgalactiae*, *Str. uberis* and *Staphylococcus pyogenes*. The other organisms which appear in clinical outbreaks of the disease do not occur so frequently, but it would be unusual in the random sampling of any herd of over 20 cows in this country not to find at least two, and more probably three, of the organisms named above; frequently all four are present.

What has happened with these organisms has been a change of their importance in mastitis. *Str. agalactiae* differs from the other three in that it will not multiply on the intact skin of the udder and teats, and is largely confined to the inside of the udder. Because it is a streptococcus it is sensitive to penicillin and it is possible to eradicate this infection entirely from a herd and maintain the herd free for all time, unless the infection is reintroduced into the herd.

It would be misleading if the impression were left that this is a simple operation but it *is* possible, although certain cows which resist treatment may have to be culled from the herd.

With the other common mastitis organisms such as the staphylococci, the position is not so satisfactory. These organisms are found in other parts of the cow, even in other animals, and their ability to multiply on the intact skin of the udder and teats makes eradication merely by treatment of infected udders (as can be done in the case of *Str. agalactiae* mastitis) a procedure of very little value. Inevitably reinfection occurs—and in as short a period as two or three months the state of infection can be as bad as it was before treatment began.

Importance of clean milking

Apart from treatment of infected cows, there are two other possible methods of controlling mastitis: by vaccination, and by hygienic control of the spread of infection.

Vaccination seems, on the surface, to be an attractive proposition but, as has already been said, mastitis is due to many different organisms and it is obviously out of the question to produce a vaccine which could protect cows against all infections. It is not even possible yet to protect cows by vaccination against even *one* species of organism, although recent work on staphylococcal vaccination has raised hopes that at least this one form of mastitis can be controlled in this way.

Because mastitis is infectious, a practical method of attacking it is to prevent infection from ever getting into the udder. From a number of experiments carried out at Weybridge and at other research institutes, it has been shown that many mastitis infections are carried from cow to cow almost entirely during milking by means of the milkers' hands, the udder cloths and the teat clusters. It is believed that in nearly all cases of mastitis the infection enters the udder through the teat canal. If infection can be kept from reaching the cows it follows that mastitis as a herd problem will be controlled.

It has been shown experimentally that such transfer of infection from cow to cow can be prevented and, if the following simple rules are followed, the problem of mastitis will be considerably reduced in importance.

1. Use the strip-cup *before* washing the cows so that the hands are immersed in disinfectant immediately after being exposed to possible infection.
2. Since infection can multiply on the skin of the udder and teats, wash the cows' udders with a solution of a suitable disinfectant, using either an individual sterile udder cloth or a paper towel which can be used once and disposed of.
3. After milking each cow the cluster must be disinfected. Dipping clusters in disinfectant is not effective, but running cold water through the cluster via the long milk tube for 15 seconds will remove most of the infection. If hot water (at 90°C) is used instead of cold water, the flushing time can be reduced to six seconds.
4. All known infected cows must be milked last.

It is recognized that these suggestions are more applicable in a milking parlour than in a bucket plant, but efforts are being made to evolve a method which can be adopted in a cowshed.

These suggestions, it is believed, will go a long way towards controlling mastitis, but they will only do so if it is understood that the fight against

mastitis is unceasing and that these hygienic principles must be put into practice twice a day for every day of every year.

So far, this hygienic control has been shown to work in experimental herds but it is hoped shortly to carry out large-scale field trials in commercial herds to find out just how effective these methods will be under field conditions.

Prevention is better than cure, and it is money well spent on such items as disinfectant and udder cloths plus a little extra labour if we can save some of the £10 million which it has been estimated is the annual loss from mastitis.

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U.S. Agricultural Education in Transition

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Mr. Edmunds, who has recently returned to England after 2 years as British Agricultural Attaché in Washington, describes the trends in farming education in the U.S.A. The article is of undoubted interest to those who think about the training of British farmers of the future.

MODERN farming is much broader than the narrow dictionary definition, "the art or science of cultivating the soil". It is but one link in the long chain of feeding and clothing people. The chain begins many jobs before the farm is reached and continues in several processes after the raw food and fibre leave the farm gate. For this whole complex of farm production and distribution functions, the term "Agri-business" has been coined.

Farming is now in the middle of its third great revolution. The first came early in the nineteenth century when animal energy replaced human toil. The second began in the 1920s, with the substitution of mechanical energy for animal power. The third and present one is the undergirdling of agricultural production and marketing with vast amounts of science, technology and business management.

A recent study[1] envisages that by the end of the century the U.S. will probably have only 300,000 to 400,000 commercial farms, a decline of three-quarters from the 1·7 million in 1960. "These fewer but larger farms," says the report, "will probably produce over 90 per cent of the farm product, or an output of some \$100,000 (£35,000) per commercial farm. This compares with about \$14,000 (£4,900) in 1960. Yet due to further mechanization, the average commercial farm 40 years hence will employ no more labour than in 1960. This means that labour productivity can be expected to go up a fantastic 500 to 600 per cent."

The report goes on to state that commercial farms will be laid out and run like highly mechanized industrial plants. Crop and livestock production will

be integrated into a comprehensive materials handling and marketing system. More emphasis will be placed on management, accountancy and control; more highly specialized contract services will be used. Farmers will use large amounts of credits, and buy and produce to more exact specifications. All this is not fiction. In fact, in California American family farming is already history.

If judged on production alone, then the third revolution is being taken by U.S. farmers in their stride. So much so that considerable political and economic pressures have been turned on them to reduce the flow from the farm taps. Very recently Secretary of Agriculture Freeman said, "One of the most significant characteristics of our age is the fact that physical, scientific and technological progress is far outrunning social, political and economic change". Or to put it in another way, the limitations of the human stomach to absorb more food is of considerable importance in domestic agricultural economics.

This rapidly changing pattern of farming reflects itself in much soul searching on the part of the U.S. educational authorities at school and university levels. These efforts can be conveniently discussed by first considering what is called Vocational Agriculture (Vo-Ag).

Vocational agriculture in schools

This is just one segment of the overall programme of vocational education and is a Federal-State joint venture. Federal funds are made available, provided there is public supervision and control over the courses and students are over 14 years of age. The backbone of the vocational agriculture courses comes from classes organized in many schools for boys who are preparing for farming. Apart from classroom studies, considerable emphasis is given to training in the selection, care, maintenance and operation of modern farm machinery. Instruction is also provided for erection and maintenance of farm buildings, fences and other equipment.

An attractive feature is the "supervised farming programme", where the student is encouraged to put into practice the knowledge gained in the classroom. The Vo-Ag teacher makes frequent visits to the boys' home farm, supervising and helping with the development of a plan. It usually starts with rearing a litter of pigs or a few calves. As they advance in their work, they are encouraged to expand and, provided Dad is willing, to take over the management of the farm at an early age.

Vocational training is, however, coming under fire. Criticisms are made that emphasis on it in high schools has brought to the universities many students with inadequate grounding in English, mathematics, the sciences and social sciences. It is also contended that those boys who become farmers—perhaps two out of every five—will find that vocational skills learned in school will be obsolete within a few years.

Two-year university courses

For those who wish to pursue their vocational skills a little further, most universities have a two-year agricultural course. Its function is to provide training for young men destined for farming or for positions in closely allied businesses.

Thus the course at Cornell University has been organized on a seven curricula basis, giving preparation for the major types of farming in New York State. A student selects one of these, the choice being made from the following: Dairy Farming, General Livestock Farming, Poultry Farming, Fruit-Growing, Vegetable Production, General Farming, or General Floriculture and ornamental Horticulture.

The breakdown of the Dairy Farming curriculum is as follows:

FIRST YEAR

Autumn term	*Spring term*
Extension Teaching (oral and written expression).	Extension Teaching.
Animal Husbandry.	Introd. to Field Crops.
Introd. Agric. Chemistry.	Soils.
Education (Reading Imp. programme).	Dairy Cattle.
Physical Education.	Dairy Cattle judging.
Ag. Economics or Ag. Engineering.	Physical Educ. Elective.

SECOND YEAR

Autumn term	*Spring term*
Livestock Feeding.	Farm Management.
Animal Breeding.	Animal Health.
Physical Education.	Dairy Production.
Elective (choice of Agric. Econ., Agric. Eng., Botany, Poultry Husb.).	Physic. Education.
	Elective (choice of Ag. Eng., Poultry Husb., Botany, Entomology).

Four-year B.S. degree course

Most B.S. degrees are received after a four-year period, but recently a few universities have started a three-year stretch, composed of four terms of 10 weeks each. There is considerable variation in curricula between U.S. universities, and to give a single example could be misleading. However, as a general illustration, the programme adopted by the University of Maryland has a good deal in common with similar institutions in other States. Thus the four-year degree can be obtained in General Agriculture, Agric. Chemistry, Agric. Economics, Agric. and Extension Education, Agric. Engineering, Soils, Animal Husbandry, Botany, Dairy Husbandry, Entomology, Horticulture and Poultry Husbandry.

The course programme for the first year is essentially the same for all students. About half the time is devoted to Composition and American Literature, American Government, American Sociology, Physical and Military Training; the other half is spent on the study of principles of Agriculture, Chemistry, Botany, Zoology, Crop Production and Animal Husbandry. In the second year there is slightly more specialization, but the liberal arts still take up to about a third of the time. In the third year they drop to about a quarter, but in the final year they cease to be in the curriculum.

Discussion

There is, however, little complacency about the nature and quality of undergraduate training. For example, the titles of a few recent addresses are:

1. Significance of recent changes in our agricultural economy to the nature and scope of higher education in agriculture.

2. The widening gap between vocational emphasis and scientific or professional education.
3. A general look at objectives and the organization of agricultural instruction in higher education.
4. The new look in agricultural college curricula.
5. Curricular specialization and course proliferation versus basic and general education.

This list could be extended to much greater length, giving the impression that the pattern of agricultural education is being well and truly raked. But there is no indication of any weakening in the long and firmly held doctrine that every American boy and girl is entitled to a university education. Every effort is made to provide facilities of such a range as to make British efforts look puny indeed. Although many students enter these seats of learning, a goodly number fail to make the grade after the first year. The wastage is high by British standards.

Neither is there much change in the philosophy that a student, whether he be science or arts, benefits greatly from a liberal education. This point was well expressed by Dr. John A. Hannah, President of Michigan State University, when recently he said, "We would agree, I hope, that we do our best when we give a student a rock of moral values on which to plant one foot and a rock of understanding of the principles underlying his field of specialization on which to plant the other. So established, he could withstand the shock of changes which beyond doubt will continue to pour over him in the long years ahead".

But despite the facilities available, the agricultural enrolment of undergraduate and graduate students has declined considerably in relation to total enrolment in the land grant institutions. In 1950 there were 40,837 students of agriculture; by 1959 it was 40,732 and the most recent figure is 41,054. Percentagewise, however, there was a fall from 9·8 in 1950 to 6·4 in 1960.[3]

This has been considered by some authorities as indicating that agricultural curricula need modifying to bring them into line with a rapidly changing world. Every branch of the physical and biological sciences has seen the emergence and development of many new theoretical and applied disciplines, each now requiring more time for mastery than was formerly needed for learning most of the knowledge known in the sciences.

Changes are, therefore, thought to be necessary, despite the fact that, "changing a curriculum is about as difficult as moving an old cemetery". Many educators, but not all, would have vocational skills removed from a university course. These, although considered essential, should be acquired either before coming to the university, or in summer vacations, or instilled by employers themselves in the form of "on the job training". There has been some resistance in the past from employers on this point, but it seems to be diminishing. Again most of them, perhaps all educators, would like to see the end of instruction in grammar, lower mathematics and lower English which in the past was provided in the first year of a student's life. Pennsylvania has made a start in this direction.

The time and facilities thus liberated could be and are being used to strengthen both the arts and scientific cours... tated earlier, the social sciences and humanities are firmly entrenched, to such an extent that in the

view of one authority "students of a four-year course in Agriculture should have a broad and general education with not more than one fourth of their credits in agricultural subjects". There is no disagreement on the desirability of including the liberal arts; there is conflict, however, on how much it should be.

As regards professional courses, there is a reorientation towards three broad areas, important to many positions open to graduates. They are (1) basic courses in plant production, (2) those related to animal production, (3) agricultural economics and agricultural business. The latter, a broader concept than just Farm Management, is firmly adopted in most universities, and this seems to meet with wide approval.

However, courses for a General Agriculture degree are seemingly on their way out, helped partly by public concern over the continuous accumulation of agricultural surpluses and partly by the need for better basic training.

Higher degrees and specialization

By comparison with its British equivalent, the strictly professional value of the American B.S. degree is lower, due primarily to the simple fact that less classroom and laboratory time is devoted to the scientific courses which comprise it. The American philosophy, however, does not regard a B.S. as a specialized degree and therefore any comparison should not be pushed very hard or indeed made at all.

Nevertheless, highly-trained and well-qualified specialists are needed more than ever, and this means a M.S. or preferably a Ph.D. degree. But here again, the reaction against over- or super-specialization is quite marked. To some extent this is an outcome or breaking away from the modelling of U.S. graduate schools on the German pattern. To quote, "German education featured the great professor giving great lectures and having little else to do with the students beyond examining them to test their professional competence. It featured the library, the laboratory and research. It insisted on the advancement of knowledge and the publication of dissertations, abstracts, monographs and papers. It exalted the monolithic professor to a pitch which our present democratic civilization would not tolerate".[3]

Few critics of U.S. graduate schools would deny that they have a very important role in training for research, but some claim that they have become out of balance with other legitimate objectives. But despite the numerous observations concerning over-specialization, it seems to be widely agreed that the broadening influence of a liberal education should come during the undergraduate career or as post-doctoral training. The hard fact is that specialists must be produced, and only an intensive graduate training will do this.

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Herringbone Parlour in 1962

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Routine work can take less time in a herringbone parlour—not necessarily at the cow's expense—and throughput can be improved in high- or low-yielding herds.

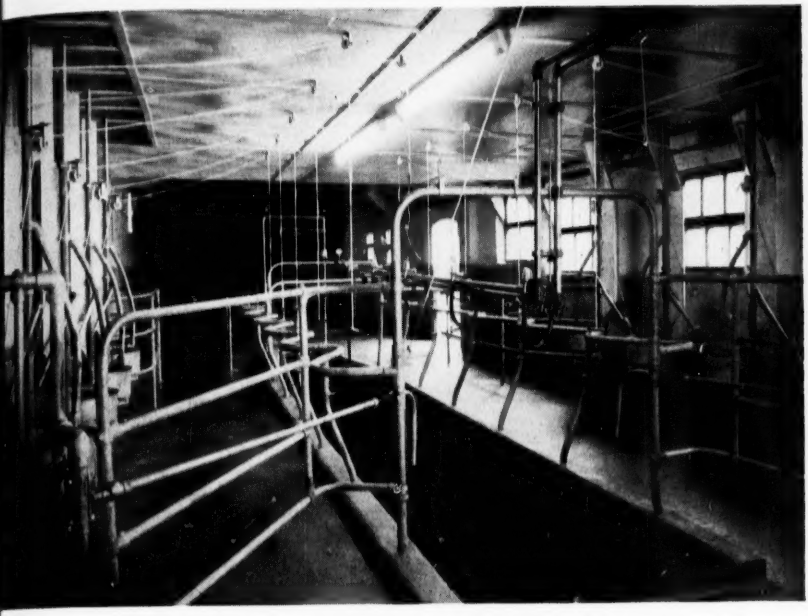
MANY people regard a herringbone milking parlour as some kind of ogre, but it has now been clearly established that in practice this is not the case. Milking parlours are being used to cope successfully with widely differing herds and conditions and have proved to be flexible in operation. It is also popularly believed that the herringbone parlour is a new invention. In fact, a report of such a parlour appeared in the *Farm Implement and Machinery Review* (England) as long ago as October, 1916.

As with other parlours and cowsheds, extravagant claims of throughput have been made from time to time. Careful time studies have shown that one man can milk up to 60 cows per hour. It can be expected that in any parlour with two stalls to each milking unit, a throughput of 10 cows per unit per hour can be obtained where the average herd yield is about 950 gallons per cow, provided overmilking is not excessive. Thus four units and one man, under average conditions, would give a throughput of about 40 cows per hour, and five units and one man a throughput of about 50 cows per man-hour, at that yield. The more milk a cow gives, the longer it takes to milk her out, and so with higher-yielding herds the throughput would be rather less.

The number of units that a man can manage properly depends on the time taken to carry out the routine on one cow, and the time taken for a cow to milk out. To reach a performance of 58 cows per hour, with one man in a five-unit parlour and cows giving 16 lb of milk per milking, it would be necessary for the routine work to be done in one minute. This routine time would be made up of "fixed" and variable elements. From the time studies shown below, fixed elements for a herringbone parlour can be assessed at say:

	Min. per cow
Let in	0·12
Let out	0·05
Apply the unit	0·13
Remove the unit	0·10
Travel time of one man	0·10
Total	0·50

This leaves 0·50 minutes per cow for the preparation of the cow (washing udder and drawing foremilk), stripping and any delay (cow kicking off unit, treatment for mastitis, man's personal delay time). The minimum preparation to an acceptable hygienic standard of a cow kept in reasonable condition is not likely to be carried out in less than 0·25 minutes. Clearly, to obtain the potential throughput under these conditions the work has to be well organized and stripping reduced to an absolute minimum.



Interior of 5-unit 10-stall herringbone milking parlour looking from the dairy towards the covered collecting area.

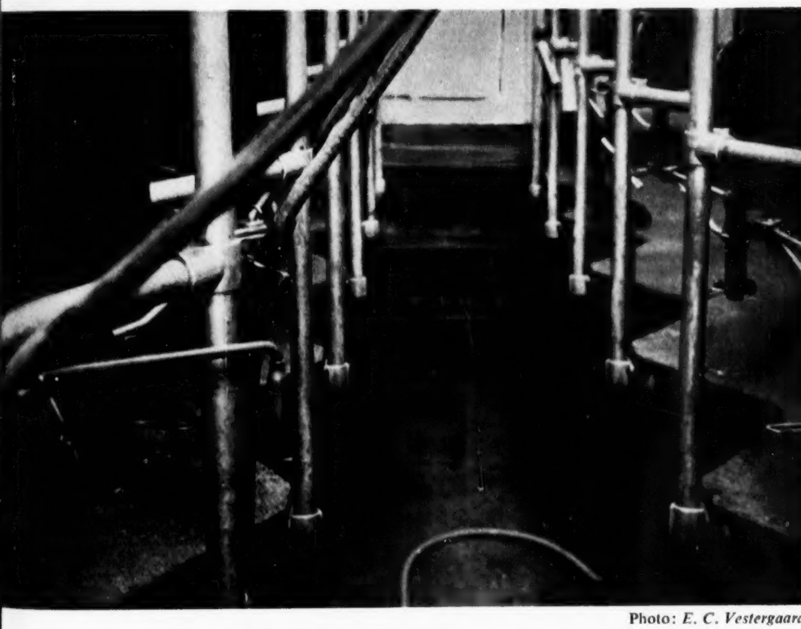


Photo: *E. C. Vestergaard*

Interior of an 8-unit 16-stall herringbone milking parlour, showing the cantilever over the pit.

Photos: *Boots*

Above. Eye-bolt strainers in an end post.

Below. Butterfly wire strainers are an alternative to eye-bolts.

(Article on pp. 655-8)

Photos: *Boots*

Above. A sprung floating fence. The bottom board floats when the stream rises.

Below. Chestnut droppers tend to slip along the wires unless the wires are stapled in a zig-zag fashion.

Hybrid Vigour in Pigs (Article on pp. 638-40)

Photo: *J. Butler-Kearney*

A pen of traditional "blue and white" pigs.

Photo: *Pig Farming*

Large White cross Essex pigs at Terrington Experimental Husbandry Farm.

In the same parlour, if the cow's yield had been 22 lb per milking, a throughput of 52 cows per hour could be obtained with a work routine of 1·2 minutes per cow. In a four-unit parlour with a yield of 16 lb milk per cow per milking, a throughput of 48 cows per hour could be obtained with a work routine of 1·3 minutes per cow. In a four-unit parlour with a yield of 22 lb milk per cow per milking, 41 cows per hour could be put through, with a work routine of 1·5 minutes per cow.

The herringbone parlour permits the time taken for letting in and letting out cows to be reduced, and also reduces the distance the operator travels during milking, making it possible for one man to handle four units comfortably with an average herd, and five units with a high-yielding herd. In practice two-man parlours do not seem to double the throughput, and two men can manage only eight units properly—four each.

Herringbone not just a large herd parlour

One man using three units can milk 38 cows per hour. A three-unit herringbone is more easily worked than either a three-unit tandem or chute, less time being taken to carry out the routine, which means in practice that it is readily kept at maximum throughput. Also it can easily be extended to manage a larger herd as expansion proceeds. The high throughput of a herringbone parlour is obtained by saving labour to enable a man to manage more units than in other parlours; it need not be at the expense of the cow. One herringbone parlour is used successfully to milk a herd with an average yield of over 1,300 gallons per cow, with a throughput of 40 cows per man hour. During the two years of parlour milking on this herd the milk yield has been steadily increasing.

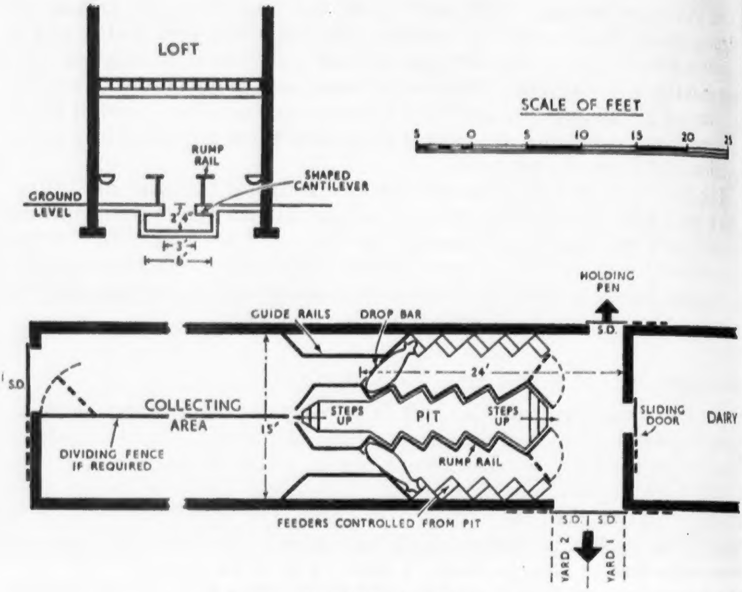
With good management and good yards, yields can be maintained just as well using a parlour as by milking in a cowshed. For good management, it is necessary to have a holding pen into which any cow can easily be diverted for special treatment. This is essential to a herringbone parlour because it is not easy to reach the head of the cow for treatment; though it is easier to get at the udder in the herringbone than in a cowshed.

Individual feeders

Individual attention to feeding can now be readily obtained by fitting food dispensers controlled from the pit. At least four of the main manufacturers have such dispensers which deliver measured quantities of food satisfactorily. They can be fitted one per stall, one to each two stalls or one each side sliding on tracks, according to requirements, and refilled from a loft or by auger from a bulk hopper.

Cows can be identified by cold brand numbers, numbered tags, or for feeding purposes by colour marking according to quantity required.

The parlour can be designed with feeding passages at each side, and a food-measuring hopper has been devised for use in such cases. However, to feed down a passage the operator must leave the pit, and I feel this is a strong disadvantage. It must take some time as a separate task, whereas the cows can be fed from the pit as they are entering. If the man leaves the pit, units on cows being milked are left unattended in a one-man parlour or in the care of one man in a two-man parlour. Some farmers prefer to feed the cows before



Layout of herringbone milking parlour.

they enter the parlour, but this entails extra labour and extra capital cost. Poaching of food by neighbouring cows can be prevented by fitting either shields between the mangers or proprietary galvanized mangers designed for the purpose. Recording can be carried out as in any parlour or cowshed by means of recording jars, once a week with bucket plant or by use of flowmeters.

With a well-managed herd, very few cows dung in the parlour, and it has been shown that this does not cause the operator any serious inconvenience. The design of the parlour can help. A concrete kerb is of little assistance, since the splashing can occur just as easily from the kerb, but a metal kerb fixed to the face of the pit does reduce splashing. If the pit is designed with the cows' floor overhanging it in a cantilever, and the cantilever is shaped to follow the curves of the rump rail, much of the dung and urine falls to the floor of the pit out of the operator's way. Of some 600 cows observed, only 8 dunged within the parlour and half of these as they were entering or leaving.

Covered collecting areas

A number of herringbone parlours in use have covered collecting areas, which adds to the comfort of cow and operator in bad weather. A covered collecting area can be built as part of the parlour, with no division between. This does away with entrance doors and so speeds up the letting in of cows, allowing the parlour to operate more smoothly. Under these circumstances it is necessary to keep the collecting area clean in the same manner as the parlour; the extra cleaning time offsets time gained in milking, but there is still the big advantage of smooth operation.

If a covered collecting area is provided as part of the parlour, it is important to have a narrow funnel entrance to the parlour about 4 or 5 feet long, so that only one cow can enter at a time; it also prevents waiting cows stealing food from the cow in the end stall. Some of the manufacturers are now fitting drop bars instead of a chain behind the last cow. A drop bar can be operated from the pit and so saves time.

To sum up, the herringbone parlour has proved itself much more flexible than at first thought and can satisfactorily deal with both high- and low-yielding cows just as well as any other parlour or cowshed, but with a far quicker throughput because a man is able to manage more units.

Thurgarton Fences

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Recent developments in controlled grazing have emphasized the need for cheap and reliable fences, and this article describes some types which have proved effective at Boots Farms at Thurgarton.

AT last high tensile wire is finding its way into farming, especially for fences. It is much stronger and easier to tighten than soft farm wire because it is more strongly elastic. It is more economical than farm wire (8 g) because high tensile wire of much smaller gauges (10 g and 12 g) goes much further. One hundredweight of 8 g, 10 g, and 12 g contains 550, 880, and 1293 yards of wire respectively. Yet both types are sold by the hundredweight and there is no appreciable difference in the cost.

On first encountering high tensile wire, one is confronted with new problems. Compared with farm wire, it poses different problems, not more difficult ones. First, when unwinding the wire from the coils, keep it taut to prevent it buckling, recoiling and kinking. If the wire is fed from the coil which is allowed to roll around as the wire is pulled away, all you have to ensure is that the wire is kept taut. But if the coil is held by another person and the wire paid out by slipping it from the coil held at right-angles to the line of pull, then the person walking away must unwind the twists in the wire as he goes along the line of the proposed fence. The loose end of the wire must not be released, otherwise it will coil up again and make more handling problems. The solution is to stick the end in the ground if both hands have to be free.

Very much heavier tools—wire cutters, pliers and proper wire joiners—are necessary than is the case with ordinary farm wire. More care is needed with high tensile wire for it can whip, fly and cut dangerously if handled carelessly.

It is necessary to make good joints, not sloppy ones. The Blundell Wire Joiner is a tradesman's tool and worth having for high tensile wire. A home-made tool serves well, and can be made from a piece of hard steel 8 inches

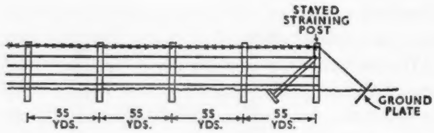

Diagram 1.

long and of roughly half-inch-square section by drilling a neat hole through near one end to take a 10 g wire, and another at the other to take a 12 g wire. To make a joint, the two wires are held in the mouth of a heavy pair of pliers with the ends overlapping. The tool is slipped up on the wire almost to the pliers and rotated around the other wire held taut. The other loose end of wire is similarly wrapped tightly around its opposite.

The galvanizing is easily stripped off high tensile wire when making joints, so paint them immediately with a galvanizing paint to protect them from rust.

Anchoring the ends

It is of fundamental importance that the ends of the high tensile wires forming a fence should be attached to solidly firm ground-plates, driven directly into the ground or to immovable posts held in position by guy wires firmly fixed to the ground-plates (see diagram 1). Direct attachment of the wires to galvanized threaded eye-bolts, which in turn are attached to ground-plates, is recommended. The eye-bolts, at 18*s*. 9*d*. per dozen, make it easy to fit the wire to fence supports and facilitate nice adjustment for tautness. A great deal of investigation has been carried out to design a cheap and durable ground-plate which can be driven into the ground easily and without damage.

Such ground-plates are first placed at each end of a main straight line of fencing. The wires are paid out in turn and attached to them by eye-bolts at both ends. Each wire is separately raised to its appropriate height above the ground and loose-stapled at the required position on the nearby support posts. At suitable intervals (30–50 yards) intermediate light posts are placed on the line of fence to support it and to fit it to the contour of the ground. Light creosoted chestnut paling droppers are then stapled with 1¼-inch staples to the wires at intervals of 2–3 yards along the fence. A guide pattern stick, marked where the wires should be, may be placed alongside the dropper when the staples are driven in (with a heavy hammer held behind the dropper). The staples are so arranged that the outside wires are 2 inches from each end of the dropper and they are driven in in zig-zag form. It is best to begin this by laying the dropper along the bottom wire and to drive in the staple obliquely on the wire so that when the dropper is raised to the vertical it grips the wire very firmly. Such stapling prevents the droppers running along the wires or taking up oblique positions. The droppers should be clear of the ground, a two-inch interval being allowed between ground and dropper end (see diagram 2).

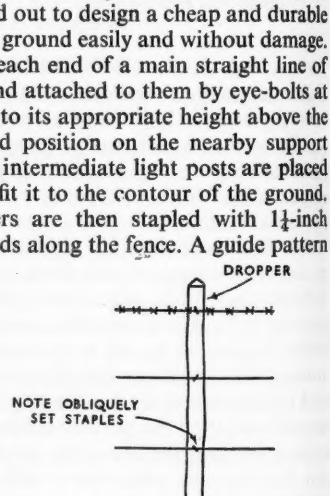

Diagram 2.

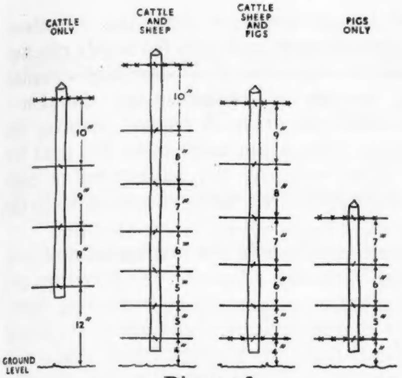

Diagram 3.

A recent modification in design has eliminated the need to drive in heavy posts. Functionally designed posts are placed at infrequent intervals along the fence, and they support its several wires on a vertical arm. Small key projections on their base-line fix them to the ground. These redesigned supports reduce the time taken to erect fences to a fraction of that needed when posts have to be driven into the ground. They also make them readily portable. For removal, the supports are collected, the fence is laid flat and then rolled up or towed into the new position.

Diagram 3 shows some fences which may be erected on this principle for different types of stock, with various arrangements of barbed and plain wire. The barbed wire at the top may be replaced by an electrified plain wire if desired. In this case, fence supports can be fitted at their apex with wheel insulators and the wire connected to an electric fencer. Electrification from the mains via an approved fencing unit, adequately earthed, is very satisfactory indeed.

Electrified sprung fencing

The sprung fence principle has also been adapted to electric fencing to give a cheap, near-permanent fence around rotationally-grazed paddocks. Fence supports are placed at 40–60-yard intervals and the end ones are supported by guy wires which carry chestnut-paling droppers to make them obvious to animal and man. Two 12 g wires are passed around insulators at each end of the fence and over and under intermediates, drawn conveniently tight and joined. Spreaders are positioned between the wires, slid towards the insulators to complete the tightening, and fixed in position. Wire joints and staples are painted to prevent rust, and the whole is electrified from the mains via an approved fencing unit, adequately earthed (see diagram 4).

Increasing need for fences

Recent opinion is supporting the idea of movable electric fences acting as barriers to a feed-face, in the field and in buildings, as a major advance for providing the animals with controlled quantities of new grazing as many times per day or week as is thought desirable and economic.

During the last few years, the creep principle of allowing lambs (or at Thurgarton, lambs and calves) to forage ahead of their dams into highly nutritious, abundant and palatable grazing has spurred on the development of new fencing methods which provide barriers against the larger animals, and access forward for the younger and smaller animals.

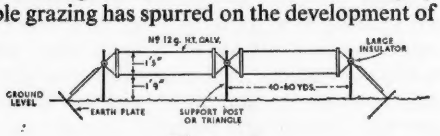

Diagram 4.

Appreciation that a degree of hunger amongst the dams stimulates appetite in their offspring in the forward creep area calls for highly effective fences. Further, understanding of the importance of carefully designed grazing routines, providing rest periods of predetermined duration—increasing as the season advances—for the grass to recover involves the division of the grazing into paddocks. This again emphasizes the need for cheap and effective fences. Still more recently, the advantages of high density stocking rates and correspondingly short grazing periods point to the need for small paddocks.

These trends have high-lighted new problems in the management of very intensive units where high stocking rates are adopted. The problems are fundamentally of an animal-psychological nature, either expressing themselves as bullying the more timid or as mass hysterical conditions associated with fear, surprise or mere cumulative disturbance. The best answer discovered so far, though the principle is probably as old as animal husbandry, is to reduce the size of the group (the number of animals); and this necessarily involves reducing the size of the paddock and still more fencing if "large group" husbandry problems are to be avoided. Cheap and reliable fences are more important than ever before in livestock production.

★ NEXT MONTH ★

Some articles of outstanding interest

THE PROSPECTS OF ERADICATING ANIMAL DISEASES *by Sir John Ritchie*

PIG FEEDING *by Dr. Howard S. Teague*

DISPOSAL OF FARM WASTE PRODUCTS *by H. Fish*

SUMMER MILK *by R. J. Halley*

F. P. Chamberlain

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This is the first of a series of articles on twentieth-century farmers who, by precept and practice, have enriched the industry with new ideas and new methods.

IT would be easy for a newcomer to farming to imagine that simplification to keep pace with increasing labour costs and capital requirements is entirely new. Nothing would be further from the truth. As long ago as 1910 the late Mr. F. P. Chamberlain was embarking on the development of an ultra-simple system of arable farming which is now widely known throughout the country by his name. Forward-looking farmers are even now adopting many of the principles which guided him.

Frederick Philip Chamberlain was born at Ramsbury, in Wiltshire, and spent his early life on a mixed farm in that parish. He took over the tenancy of Crowmarsh Battle Farm, at Benson in south Oxfordshire, in 1896, bought it in 1900, and was to farm it continuously until his death, in full work, at the age of 86 in 1952. It was a farm fairly typical of that area between the Thames and the Chilterns, 450 acres in size and narrow in shape, with the buildings at one end near the river. The soil varied from valley gravel at that point, through alluvium and strong loam up to thinnish chalk at the extremity on the hill. It had been farmed by his predecessor, William Newton, on traditional lines, with a Shorthorn dairy herd round the main buildings, and a well-known flock of pedigree Hampshire Down sheep, kept in hurdles, on the chalky slopes furthest from the homestead.

From the start Chamberlain showed that he did not believe implicitly that livestock were essential to the economic success of a farm, or for that matter for the maintenance of fertility. Furthermore he had no particular respect for the folded flock so revered in late nineteenth century light-land farming. He had not been on the farm for a year before the flock was sold and he had decided to farm the outlying land without any stock at all. He did, however, retain a dairy herd on the block of land near the river, though he was never an enthusiast for the dairy cow.

This scepticism of the value of the golden hoof did not mean that he failed to attach great importance to maintaining soil condition. Far from it, for he took considerable pains to maintain the structure of his land through the return of organic matter to the soil, and he was a firm believer, even in those days, of the value of moderate applications of fertilizer to compensate for the nutrients which were not being supplied in dressings of farmyard manure. The outlying land was eminently suited to barley growing, with parts of the lower slopes capable of producing useful crops of wheat. He developed there a system of frequent undersowing with short-term leys, which were either ploughed back in the autumn or cut for hay, to be sold off the farm. An occasional green crop was taken, and bastard fallowing after the hay crop was

common. Most of the land, however, was in cereals, and the ley acreage would not normally amount to more than 30 per cent in any one year.

Detailed records show the way

The prophets, of course, foretold his doom when the sheep flock was sold, and he was accused, as many pioneers have been, of robbing his land. "Chamberlain is taking out what Newton's flock put in and he won't last long", was the local saying at the time. But the prophets were wrong, for as the years went on he realized that this outlying block of land was in fact paying its way just as well as the block on which the dairy herd was situated, and which he was still farming on traditional lines. This was not just a simple "hunch" unsupported by hard facts, for Chamberlain was a meticulous keeper of records, and his books and figures show how carefully he costed everything, and what an exact account of his yields he had from year to year. He realized then—and this still further strengthens his claim to be a pioneer of modern farming—that gross output is not the be-all and end-all of profitable farming, a fact which many farmers are rediscovering today. He saw clearly that yields of corn were as good on his stockless block as on the traditionally-farmed land, but that his inputs were considerably less. Furthermore on his stockless block there was no capital investment in dairy cows, none of the labour worries that seem inseparable from a dairy herd, no need to provide winter fodder or concentrates or even summer grazing, and no need for elaborate buildings. A lesser man even then would not have had the courage to break completely with tradition and farm without livestock altogether. But Chamberlain, being the man he was, took the plunge and sold out the dairy herd in 1909, and from that date no stock have been kept on Crowmarsh Battle Farm, except for the working horses, which were replaced by tractors in the 1920s. The pasture land was all put under the plough, except for the home paddock, and has remained so until today.

Naturally the sale of the dairy herd led to further forecasts of disaster, but Chamberlain continued unperturbed with his simple system, watching his soil, recording his yields, assessing his profits and weathering successfully the financial storms of the 1920s and early 1930s (when in one year, for example, his barley showed a gross return of only £6 per acre). Those that came to scoff returned to wonder; research workers studied his system to try to determine why his crops did not suffer from cereal diseases, and economists published papers on the financial results of his farming.

With the imperative need today of reducing costs of production, it is perhaps worth while to take a closer look at the man and his system to see whether there are still some lessons to be learnt from his example.

Land improved, not exploited

The first important point to emphasize is that Fred Chamberlain was no "here today and gone tomorrow" exploiter of farms. He had a true "feel" and respect for the land, and he farmed for the future, with the belief that he should leave his farm to his successors in as good condition as he found it, or better. He was recognized in his day as an excellent tiller of the land, and as one who saw to it personally that cultivations were carried out properly and at the right time. There is no doubt that this is as important now as ever,

even though it may be easier with modern equipment. Secondly, he was not afraid to move with the times, for the steam tackle and horses on which he depended for power in his earlier years gave way to the tractor in the 1920s, the first combine appeared on the farm in the late 1930s, and his last horse was sold in 1938. These changes enabled him progressively to reduce his labour force, and thereby to keep inputs down. He appreciated the absolute necessity of artificial fertilizers, and was prepared to seek the best available advice on their use. He altered the composition of his leys when modern herbicides were introduced in the 1940s so that they could be widely used on his cereal crops without damage to the undersown seeds. As he was over 80 years old at this time, he quite clearly retained his pioneering qualities to the end of his life. Other factors in his success were his interest in economics, his meticulous recording of the yields of his crops and his accurate assessment of profit and loss. Possibly the simplicity of his system and the absence of the day-to-day worries of livestock farming made the keeping of records easier for him, but this in no way detracts from the fact that such records were ultimately the basis of his success. Many farmers today could profit from his example.

Has the simple system that he followed at Benson any application under present conditions? Much of what has been written about it has concentrated on his continuous barley cropping over a period of some fourteen years, but this rather extreme example is not really typical of what was practised on the farm as a whole. The system he followed was to crop with cereals as long as his yields appeared to be satisfactory, with very frequent undersowing of Italian ryegrass and trefoil leys (10 lb of each per acre). These were ploughed in during the late autumn, or left for a hay crop, if he considered that the land needed a change, the full aftermath being ploughed in on the lighter fields, or the land bastard fallowed on the heavier sections in preparation for wheat. Where hay was taken, the whole crop was sold off the farm, thus challenging successfully still another of the unwritten tenets of good husbandry. The light land carried a high proportion of undersown barley (about 75 per cent of the barley acreage), whereas on the heavier land wheat was alternated with barley and leys. Mustard was sown as a catch crop from time to time and ploughed in as a green manure. Unlike the late George Baylis, who also farmed a large acreage without stock, Chamberlain did not include a full fallow in his system, and only resorted to it occasionally if perennial weeds became a serious problem.

Good health of cereal crops

Rothamsted scientists investigating the success of the system in avoiding cereal diseases attributed it to the fact that his undersown leys used up all available nitrogen in the autumn and thereby helped to accelerate the death of fungal organisms, such as take-all, while the rotting down of the ploughed-in material provided plenty of nitrogen when the succeeding barley crop had most need of it. Furthermore the prolonged use of dressings of some 2–3 cwt of superphosphate, ½ cwt muriate of potash and 1–2 cwt sulphate of ammonia for his cereal crops had raised the available essential nutrients to a high level, which did much to ensure a healthy crop.

His yields were not high by modern standards, so that some of his success in avoiding the worst dangers of more or less continuous cereal cropping can

perhaps be attributed to his determination not to force or exhaust his land by trying to extract very high yields from it. His policy was to farm as simply as he could, and to produce crops with the minimum of expenditure consonant with keeping up the condition of the soil. He was perfectly satisfied with modest yields, so long as he could keep his costs of production low. This surely is what is needed today, and it is interesting to see relatively low cost systems of production, very similar to his, being adopted in many of the more extensive arable farming districts. From the example of Crowmarsh Battle there seems little reason to fear soil erosion or severe disease problems if the precautions that Chamberlain took are carefully followed. There has been no evidence at all of a decline in yields; in fact the tendency has been for them to increase, particularly in recent years. The farms now managed by his son on the same system total 1,100 acres, and some fields from the original farm have, of course, now been without stock for over sixty years and show no deterioration.

During the war, potatoes and sugar beet were introduced on some of the more suitable fields, and their cultivation continued after the emergency was over. A portion of the farm—140 acres—at the foot of the hill was lost to an aerodrome at this stage, and Chamberlain accepted this blow philosophically. "If the nation needs my land, they must have it" he said, an attitude which typified his intense patriotism and strength of character, for many men would have fought tooth and nail to preserve some of the best land on their farms. To compensate for this loss he purchased more land of lighter and thinner texture at the extremity of the farm, and was also persuaded by the W.A.E.C. to clear and crop some 50 acres of derelict common land at Ewelme, which he did most successfully.

Fred Chamberlain was a modest man with a fertile and far-seeing brain, who was never afraid to follow up his strong convictions in the face of tradition and long-established beliefs, once he had assured himself that they were sound. He was not infallible, however, for his son recalls with amusement a determination to grow apples on a commercial scale. Initially the trees were planted on the valley gravel but failed to crop satisfactorily. Nothing daunted, he had each tree carefully dug up and replanted on the chalk, where the results were equally disastrous. It was not until several years of attempted remedies had failed that he finally gave in and had them grubbed up. Even the best and the most sensible men can make mistakes!

He was not the type of man to seek fame or notoriety for his system, and he did not play a particularly prominent part in public affairs, except as a member of his N.F.U. branch and the Agricultural Executive Committee. His recreations were billiards, a game that he greatly enjoyed, and an occasional visit to Royal Ascot, but his main and abiding interests were his farm and his family. He was a perfect example of the very best type of farmer of the early twentieth century, well versed in the arts of husbandry, with a great respect for the well-being of the land that he farmed, but at the same time always ready to accept and develop new ideas.

Potatoes—Do they Pay?

W. L. HINTON, B.A.
School of Agriculture, Cambridge University

It is not the apparent profit from potatoes alone, but what they contribute to the total farm income that counts.

WHAT the individual farmer wants to know before deciding the acreage he can afford to put down to potatoes is the likely profit resulting from the enterprise. This profit potential depends on the limits set by his own management capabilities within the scope of his own farm acreage. Apart from the level of prices, which are not within the grower's control anyway, the two features which decide whether or not potatoes will pay are the gross margin arising from the enterprise and the success with which a given acreage of potatoes may be produced without disturbing the supply of labour to the other farm enterprises. It is the contribution that the potato crop can make to the *total* income of the farm in conjunction with the other enterprises which matters, not merely the apparent profit of the enterprise judged in isolation.

Gross margin

A look at the structure of potato costs reveals that as much as 60 per cent of the costs are made up of labour and overheads. These costs are fixed, and cannot be varied, in the short term at least; they have, in fact, to be met out of total farm receipts whatever crops are grown. Planning the farm for profit is a matter of selecting the various enterprises and the size of each so that each enterprise makes the best use of the fixed resources on the farm. For this reason attention may profitably be focussed on the costs which are specific to each farm enterprise, in the case of potatoes, seeds, fertilizer, sprays and casual labour, and their relation to the revenue produced by the enterprise. The usefulness or otherwise of an enterprise in promoting farm profit (the gross margin) is assessed by first estimating the receipts, then deducting the variable costs, those which are specific to the individual enterprise and quite apart from the fixed costs.

With potatoes, one cannot hope to predict receipts accurately, because of the wide fluctuations in price from year to year; over three recent years 1956/7–1959/60 prices rose by over 100 per cent between the first two seasons, then the price remained stable for the next season and finally fell by 40 per cent in the last season. While guaranteed prices are still in operation, a price closely related to guarantee price does, however, give a reasonable standard for planning purposes. This can be more than the actual guarantee price because the average market price is normally above the guarantee price. The value of the crop per acre is, of course, decided by yield as well as the price per ton. Yield will vary from farm to farm, and yield estimates are better based on what the grower knows he can do, taking good and bad years together.

The amount of the variable costs, too, are determined by the particular situation on each farm. Crops which rely heavily on casual labour, for instance, will have lower fixed labour charges than other crops. The gross margin on potatoes is demonstrated below, using the results of the Cambridge University survey in Holland (Lincs.)*. The variable costs shown are based on the practice followed on many farms in Lincolnshire, but price per ton is taken at a conservative figure of £14 per ton (15*s*. per ton above the guarantee price for 1961/2). The actual gross margin on any one farm will depend, of course, on the variable costs on the farm concerned and the level of yield and price.

Gross margin per acre. Maincrop potatoes

	£
RECEIPTS 8 tons @ £14	112
VARIABLE COSTS	
Seed	29
Fertilizer	14
Sprays	3
Casual labour	12
TOTAL VARIABLE COSTS	58
GROSS MARGIN PER ACRE	54

Having arrived at the gross margin for the potato crop, the value of the crop to the farm business is assessed by comparing this gross margin with that given by other important crops on the farm. The procedure is similar to that already demonstrated for potatoes, for many crops (wheat and sugar beet for example) prices are more stable, so receipts can be estimated with greater confidence.

Labour programme

A cropping programme should obviously include those crops which give higher margins per acre. But the acreage which can be given over to each crop is limited, apart from rotation needs, by the amount of labour and equipment available. Labour bottlenecks arise from competition between certain crops at a given period of the year. Planting and harvesting, of course, commonly cause clashes between different crops for the available labour. If by growing too large an acreage of a crop having a high gross margin the labour programme for the farm crops as a whole is upset, then the overall farm profit will suffer. In fact several crops are necessary to spread the harvesting load, the planting of winter corn must go ahead when late-harvested root crops are being lifted, and spring corn must be sown when potatoes are being planted.

Successful planning means fitting in so many acres of certain crops with their attendant labour requirements, in order to make the best use of the available labour supply. Again, labour requirements are affected by the degree to which the production of certain crops can be mechanized. Put the other way round, provided the labour programme can be balanced over the year, then crops with higher rather than lower gross margins are the ones to grow. In some cases, where the pattern of cropping puts pressure on labour, an extra regular man would make the situation much easier, but usually this is too expensive a remedy. If casual labour is available, the problem is simplified. But total labour requirements for crops do depend so much on the acreage

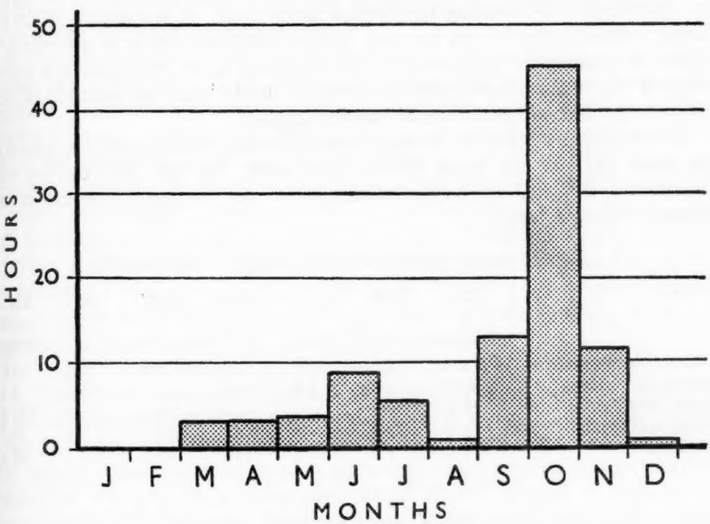
*HINTON, W. L. and PLAISTER, A. J. (December 1960). *Potatoes for Profit*.

and type of each crop grown, and it is important to make an analysis of these for the peak periods at least, based on the proposed cropping. Where men are partly employed on livestock enterprises, their time available for crops needs to be taken into account too. It is important in sizing up the labour position to know how much casual labour is available and for which crops, whether for example corn is harvested by a farm threshing machine, a farm combine, or whether it is done on contract.

A typical seasonal distribution of labour for the potato crop is shown below, together with a set of standard labour requirements for different operations and the period during which they are carried out. These are presented as a guide to what might be expected by growers of maincrop potatoes in general, but the actual requirements for a given farm may be different from these.

Seasonal Labour Requirements

Maincrop Potatoes



Note. Hand planting and harvesting
Riddling—27 hours additional (Oct.-Mar.).

Looked at by each operation, this breaks down into something like the following:

Standard labour requirements for maincrop potato producer—per acre

Operations	Man-Hours	Period
Stubble cultivations	¾	Aug.–Oct.
Deep ploughing	2¾	Sept.–Jan.
Cultivations and fertilizing	3	Feb.–Apr.
Planting (3-row machine)	7¾	Mar.–May
Hand planting	13½	Mar.–May

continued

continued

Operations	Man-Hours	Period
After cultivations	4	Apr.–July
Hand-hoeing	12	May–July
Spraying	1½	June–July
Burning off	½	July–Aug.
Spin out, picking, carting and clamping	60½	Sept.–Nov.
Earth-up and clamp	6	Oct.–Nov.
Riddling and bagging	27	Oct.–Mar.

Variations arise from differences in the way in which the crop is treated. Some crops are sold straight off the field while others are clamped and later sorted and sold. Without casual labour available for the latter, there may be serious interference with spring work on other crops.

In conclusion, it may be stressed that potatoes will pay, assuming a reasonable yield, when their cropping is not allowed to upset the production of other crops having high gross margins. Interference with the labour supply to other crops, so lowering the overall farm profit, is best examined by the farmer himself who knows his own labour situation and is in a position to make the necessary adjustments to his cropping. Most important is a knowledge of which crops contribute most to his income and the selection of such crops to avoid bottlenecks in the labour supply.

Labour requirements for several crops, showing the demand for labour in the peak periods are given below. This table, like the one dealing with operations, is based on crop studies carried out by the Farm Economics Branch in recent years.

Labour requirements per acre (hours): peak months

Crop	May	June	Aug.	Sept.	Oct.	Nov.	Total man-hours
Winter wheat (combined)	—	—	2·5	1·5	2·8	0·3	10·1
Barley (combined)	0·2	—	2·8	1·2	—	0·8	9·6
Sugar beet (hand)	29·0	29·5	—	6·6	25·1	32·4	137·6
Sugar beet (complete mech.)	7·9	12·2	—	4·6	12·1	9·4	56·2
Potatoes	3·7	1·6	0·5	13·1	47·2	11·3	105·9

"Agriculture" Index

The Index to Volume 68 will be issued with the April number.

Farming Cameo: Series 2

47. Mildenhall, Suffolk

MALCOLM JENKINS, M.A. (CANTAB.)

THE Mildenhall district is situated in the north-west corner of West Suffolk with Bury St. Edmunds at its south-east extremity. There are 470 farms of more the 15 acres, comprising 105,000 farming acres. This is an area of large arable farms where the maximum acreage of cash crops, e.g., wheat, barley, sugar beet and vegetables are grown. The return from livestock products forms a very small proportion of the turnover. There are three main soil types. In the south, Boulder clay (20,000 acres); in a broad band across the centre, the coarse sand of brecklands (70,000 acres); in the north-west, an area of very variable peat soils (15,000 acres).

As its name implies, the chalky Boulder clay is alkaline, with a reasonable content of potash, but a deficiency in phosphates. Wheat grows particularly well here; yields of over 2 tons per acre are frequent. Barley, too, can be very profitable. Owing to wet soil conditions in the autumn and complications of labour management, sugar beet is losing favour. Intensive cereal growing does not appear on the Boulder clay soils to have any adverse effects on soil or profits. Provided the drainage and manurial policy is right, there seems little justification for a more diversified policy. Grazing livestock are not, therefore, important; the organic matter and soil texture can be kept up by other means. There are only a few dairy herds. Where it is necessary to keep some livestock to utilize parkland or leys sown on a really heavy field, the single-suckling method of beef production is practised.

The light soils are variable but the majority have a high fraction of coarse sand. The subsoil consists of chalk at varying depths, and it is the depth of top soil overlying the chalk that governs the value of the land. Ideally, there should be a soft chalk subsoil stratum at 18–24 inches below the surface. This usually means that the texture approaches a loamy sand and is more resistent to drought than those soils which have a higher proportion of coarse sand in their make-up. Where this type of soil occurs, the chalk subsoil is at a greater depth and is likely to be acid. This can be acute in localized areas, sometimes with pH values of 4·0. Potash is usually deficient, but there is an adequate supply of phosphates.

It is very important that the organic matter content should be maintained in the light breckland soils of Suffolk. If it is allowed to deteriorate, crop yields fall disastrously. Remedies can be sought by ploughing in straw and crop residues and the spreading of farmyard manure, but it is the three-year ley which is the greatest contributor of organic matter. A rotation commonly practised on the Breck consists of a three-year ley wheat, barley, roots, barley, barley.

The root crop will be sugar beet, carrots or kale. If the land is alkaline to a depth of at least 6 feet, then a lucerne and cocksfoot three-year ley is drilled. Should there be any acidity, a cocksfoot/white clover mixture is sown. The land must have a reasonable content of organic matter in order to establish

a lucerne ley. If this has fallen, the crop will lack vigour, it will find difficulty in absorbing potash manures and deficiency symptoms will show up. On some Breckland farms the organic matter content of the soil has been reduced to a dangerously low level by continuous arable cropping. Under these circumstances it may be imperative to drill a three-year ley mixture of cocksfoot and white clover and not attempt to establish lucerne. The cocksfoot ley must be stocked as heavily as possible and not cut for hay or silage more than necessary.

Our increased knowledge of herbage production on light soils has presented a problem in determining the best means of utilizing this extra growth. There is a limit to the expansion of dairying, due to market conditions, the supply of skilled cowmen and the lack of suitable buildings. More ewes could be kept, but good shepherds are difficult to find, and it is doubtful whether, in the future, the eastern counties will be able to compete favourably with the wetter areas of the west in cheap lamb production. Beef is thus the only alternative. A single-suckling herd does not require the same labour and, once calving is complete, is very easily managed. If the cows are fed silage on an easy-feed system, outlying fields can be used for out-wintering.

Capelle Desprez and Proctor are widely grown by a fully mechanized system. Malting barley is produced extensively and attracts a premium, due partly to early harvesting.

Trace elements are sometimes deficient and cases of boron shortage in sugar beet are occasionally recorded. The attention of the soil chemists has been drawn to the identification of magnesium and copper deficiencies in sugar beet and barley and the likely increase in yield following treatment. This investigation work is still in progress. During most springs there are cases of hypomagnesaemia in cattle and sheep, but the regular feeding with calcium magnesite appears to be checking this condition.

In the north of the district there is an area of fenland, varying considerably from the sandy skirt soils to a loamy peat overlying clay. There is also an area of chalky peat known as "White Eau", which extends to approximately 1,500 acres. This contains up to 75 per cent $CaCO_3$, a high content of phosphates and a deficiency of potash and manganese. During the formation of the Fens this used to be the bed of an old lake into which drained the rivers originating in the chalk uplands. On reaching the lake, the chalk was deposited and formed a stratum 1 to 2 feet in depth. Peat is also admixed with some silt particles.

The light peat soils form 70 per cent of the fens of Suffolk and vary in depth from 1 to 4 feet, with a high lime content and deficiencies of phosphates and potash. Because of the high pH value (7·0 and over), the trace elements manganese and copper are made unavailable and remedial sprays have to be applied.

The spring wheat, Koga II, has revolutionized cereal growing, since it is particularly resistant to these deficiencies of copper and manganese. Previously it was not possible to obtain yields of more then 15–25 cwt per acre, but this has increased the output by at least 50 per cent. These deficiencies are also apparent in other arable crops, such as sugar beet, carrots, celery and potatoes.

There is also a small area of heavier peaty loam soil where these deficiencies do not arise, the quality of potatoes is better, and the yields of winter wheat in the region of two tons per acre. Here the peat is wasting considerably, and on many fields the clay subsoil is being brought to the surface by ploughing.

Your Fixed Equipment

Farmstead Drainage

F. W. HOLDER
Chief Architect, Agricultural Land Service

Two new pieces of legislation, the Public Health Act, 1961, and the Rivers (Prevention of Pollution) Act, 1961, are directed at the problem of disposing of effluent (manure), both liquid and solid, from our farm buildings. The first relates to effluent which, in a minority of cases, discharges direct into, or otherwise finds its way to, public sewers, and places obligations on the "owner" of the effluent to comply with the requirements of the Sanitary Authority in respect of quantity, quality and composition. The regulations will affect not only those who are applying for permission to connect, but also those whose effluent is already being accepted by the Authority. The second is concerned with the pollution by farm effluent of streams and watercourses, and the River Boards are empowered to call for such discharges to be stopped or for steps to be taken to purify the effluent. In effect, farm effluent is now to be regarded as industrial effluent.

Hitherto the usual method of getting rid of farmstead drainage was to pipe it into the nearest ditch. This practice was accepted not only by farmers but by the authors of books on farm buildings as a perfectly natural thing to do. Where a little more money was available, or perhaps if conscience pricked, a "septic tank" was put in the outfall drain, but this merely delayed the passage of solid matter, leaving the liquid to pursue its polluted way, unchecked.

Farm animal manure cannot be treated by conventional methods with the same ease and efficacy as can human waste. Moreover, the sporadic nature of the discharge, sometimes "neat" and potent and at other times well diluted, means that it quickly disturbs the action of bacteria in the filters of the average treatment plant. If "nature's call" in the cowshed were accompanied automatically by a two-gallon "flush" of pure water, the story might be very different. As it is, the cost of an efficient dilution and re-circulation system, even if feasible, would be so high, and the maintenance requirements so stringent, that for all practical purposes a purification plant would not be suitable for any but the largest "factory farms".

Therefore, to meet the problems posed by the new legislation, it must be assumed that unless a farmer can connect to a public sewer or dispose of farm waste for sale, he must be prepared to keep the effluent and turn it to good use on his land.

Farmstead effluent, in common with all other sewage, passes through two stages, *collection* and *disposal*. The effluent to be collected may either be *dry* or *wet*, but obviously some may be drier and some wetter than others. *Dry* effluent relates primarily to those types of buildings where straw is used as an absorbent. This practice has become increasingly popular over the past few years. Not only is the handling problem simplified into one annual operation, but the absence of any piped discharge ensures that there is no problem of direct pollution. This method has long been associated with beef cattle, and

has more recently been used for dairy cattle, poultry (deep litter) and in a variety of ways for pigs. In the same category comes the Norwegian method of housing cattle on slatted floors, beneath which the manure is allowed to collect for ultimate removal in a fairly solid form by means of a scraper or fore-loader. With all these systems, the advantages of 100 per cent roof coverage is obvious. Open yards and pavings provide an additional problem of drainage, because of the dilution of surface manure with unwanted storm-water. The "dry cowshed", used extensively in the U.S.A., is another way of keeping the manure to a minimum.

Wet effluent is that which is either wholly liquid, or solid with a sufficient admixture of liquid to make it fluid. The "traditional" cowshed, the Scandinavian piggery, and the various types of cattle yards and piggeries with slatted floors from beneath which the manure is removed hydraulically, are systems which depend, in essence, on taking the effluent through pipes or ducts, and the polluted material requires handling as a liquid, or perhaps double-handling as liquid and solid.

Excluding the dubious exercise of attempting to purify farmstead effluent, there are four principle methods of disposal, although there will be many combinations of two or more of these when the problem is related to specific conditions.

Land treatment involves the distribution of the liquid after the removal of the grosser solids (in sedimentation tanks) through unjointed pipes laid herringbone fashion just below the surface, over an area of land. Given a suitably permeable subsoil, one acre would probably be needed to cope with the effluent from 350 cows. Alternatively, the effluent can be discharged into lagoons, but here the hygiene factor may obtrude unpleasantly. Both these systems are dependent on the permeability of the subsoil to drain off the liquid element.

Transportation is associated with the handling of the straw and manure pack from cattle yard or midden, and its distribution over the land. The term can also apply to liquid manure taken from collecting tanks; this may be once a year or more often (when applied to poultry housing or pig yards).

Storage is adopted widely in N. Ireland, where the subsoil is heavy clay. It consists of the provision of tanks, either apart from or underneath the buildings, in which the solids and liquids are collected. The capacity generally provided is 6 months' storage for solid and 3 months' for liquid manure (where the two are kept separate) and at the end of these periods the effluent is put on the land. The cost of such measures is necessarily high, but where the "yarding" system is not used and the subsoil is insufficiently permeable, there is little alternative.

Organic irrigation, sometimes known as the Gulle system, is of European origin and comparatively new to this country. It consists, briefly, of collecting the liquids and solids, thoroughly mixing and diluting them to a workable consistency, and spraying on the land through transportable pipes. The practice lends itself readily to slatted floor housing techniques and solves many of the problems of washing and surface water, by allowing them to dilute the effluent. Its main disadvantages are smell and nuisance when used in windy conditions. Maintenance of the mechanical equipment is also a considerable item of expense.

In this note it has been impossible to deal with all aspects of the problem; e.g., silage has had to be omitted. Suffice to say that silage effluent is about 200 times more potent than the human variety, and its disposal must be considered in this light. Reduction of water content in the silage is an important prerequisite to minimizing the problem of disposal. The disposal of farm effluent undoubtedly raises its own special difficulties, but these are not nearly as complicated as for some industries, especially those concerned with chemicals. Many factors are involved in deciding what measures to take, and there are no simple "do it yourself" recipes. However efficient the solution, it must in the last resort be one which is acceptable to the local Sanitary Authority and/or River Board.

THE MINISTRY'S PUBLICATIONS

Since the list published in the February, 1962, issue of *Agriculture* (p. 610), the following publications have been issued.

LEAFLETS

Up to six single copies of Advisory leaflets may be obtained free on application to the Ministry (Publications), Ruskin Avenue, Kew, Richmond, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 3d. each (by post 6d.).

ADVISORY LEAFLETS

No. 200. Seaweed as Manure (Revised)
No. 322. Taints in Milk (Revised)
No. 365. Houseflies, Blowflies and Clusterflies (Revised)
No. 434. Home Freezing of Fruit and Vegetables (Revised)
No. 454. Seeds for Leys (Revised)
No. 508. Management of Young Pigs (New)

HORTICULTURAL MACHINERY LEAFLETS

No. 4. Fuels and Firing Equipment for Nurseries (Revised) 6*d.* (by post 9*d.*)

MAJOR PUBLICATIONS

Copies are obtainable from Government Bookshops (addresses on p. 682), from any Divisional Office of the Ministry or through any bookseller at the price quoted.

BULLETINS

No. 129. Cereal Diseases (Revised) 5*s.* (by post 5*s.* 5*d.*)

This new edition provides simple and accurate descriptions of the many cereal diseases. It is intended to help all those interested in the cultivation of cereals, whether farmer, adviser on plant diseases or student.

At the Farmers' Club

Seed Dressings and Sprays—Salvation or Menace?

To discuss the use of seed dressings and sprays in terms of banner headlines in a sensational newspaper over-simplifies the whole problem, declared MR. MICHAEL BRADFORD commenting on the title of his talk to the Farmers' Club on 14th February. In order to present a balanced view, he began by outlining their role in helping to produce more food in a hungry world. Half the world's population is underfed now, and vastly increased food production will be essential to avoid future starvation, since the present world population of some 3,000 millions is likely to be doubled by the year 2000 and may well exceed 10,000 millions 50 years after that.

Man's insect enemies are both powerful and numerous. Until recently, the tsetse fly denied 4 million square miles of Africa to man. In India alone, 20 million people are afflicted with elephantiasis and malaria affects one-sixth of the human race. Both these mosquito-borne diseases seriously impair the fitness and mental outlook of their victims. Measures to control the malarial mosquito with insecticides are now protecting nearly 5,000 million people in 26 Eastern countries.

In the U.K., the loss caused by plant diseases, pests and weeds is frequently quoted as about 10 per cent. In many other countries it may be as high as 20 per cent. In addition, FAO has estimated that 5 per cent of all harvested cereals, peas, beans and oil seeds are lost in store, due to insect damage—this is equivalent to half the quantity entering world trade. The potato famine in Ireland is a classic example of what can happen when a plant disease is allowed to run unchecked. Between 1845 and 1860, a million people died and 1½ million emigrated solely due to the ravages of potato blight.

Among successful crop protection measures, Mr. Bradford cited the Ghana cocoa crop. In 1955, FAO reported that the combined depredations of swollen shoot, black pod and capsid bugs would necessitate vastly increased plantings even to maintain production, then 220,000 tons, after 1960. But since the introduction in 1957–58 of a spraying campaign to control capsid, annual production has risen to 450,000 tons—a level never before contemplated. The average yield increase after one year's spraying is about 110 per cent, and a further 50 per cent is obtained from the second year's treatment.

There is an enormous potential for crop protection chemicals in countries such as Africa, though methods of overcoming difficulties in distribution and education in their use would have to be devised. "Much more could be done on a world scale to utilize sprays and seed dressings to preserve our present harvest and increase yields on our present acreage."

Not all insects are harmful, nor are multitudes of bird species—many are positively beneficial. "In our struggles, we shall need all our friends—animal, bird, insect or plant—even if it be merely to provide us with song, scent or colour to enliven our days. It is absolutely essential to channel our

efforts into the provision of materials that kill only our foes. There are signs that this is being accomplished."

Turning to the home situation, Mr. Bradford said that although on a world scale seed dressings and sprays are in some measure a salvation, they may conceivably be a menace in our own parish. But the figures he then quoted left no doubt that here, too, crop protection is necessary. The total U.K. loss from pests, disease and weeds in growing crops, plus that from rodents in stored products, is considered to be about £140 million.

Sufficient seed dressings are sold in the U.K. to treat at least 75 per cent of all cereal seeds sown. A conservative estimate suggests that the resulting control of fungi and wireworm brings an extra 680,000 tons of grain, worth more than £18 million a year. In 1959 a million tons of sugar beet would have been lost due to virus yellows had the crop not been sprayed. Wheat bulb fly caused a loss of £1¼ million in 1953, before dual-purpose seed dressings were introduced.

A recent pilot survey of herbicide practice suggests that, by disregarding recommendations, a lot of users are failing to obtain the full benefits of many recent scientific developments in weed control. "It is false economy to bulk buy MCPA and use it for almost everything", he said. On farms where much greater discrimination in choice of weed-killer was used, results were always considerably better.

Are seed dressings and sprays a menace because of toxicity? Mr. Bradford considered that no fairer answer could be given than that contained in the recent report of Professor Sanders' Research Study Group on the use of toxic chemicals in agriculture. Pesticides receive as much scrutiny as many drugs, as regards toxicity. On average, only one non-fatal accident on farms in just under 6,000 had anything to do with chemicals in the period 1953–60—"the Regulations appear to give agricultural workers the protection they have a right to expect".

No evidence was found of illness attributable to eating food from treated crops, nor of any adverse effects on soil fertility. The poison hazard to farm livestock lies almost entirely in metallic compounds, few of which are pesticides. The seed dressings that caused increased bird deaths in spring are now used only for autumn-sown wheat in danger of bulb fly attack.

Reviewing promising new developments, Mr. Bradford mentioned menazon, which kills only aphids, leaving their predators and other insects unharmed. It shows promise as a seed dressing for peas, beans and sugar beet, as well as for treating potato tubers to control aphid-borne virus diseases. Pre-emergence weed control techniques are reducing the man hours needed to produce sugar beet and there is hope that systemic fungicides will soon be available to control mildew.

"The world's farmers and scientists are fighting a total war to preserve and increase food for mankind against the terrifying shadow of the world's increasing population . . . I consider seed dressings and sprays one of the main sinews of mankind's war to wrest food from the earth."

SYLVIA LAVERTON

Agricultural Chemicals Approval Scheme

Additions to the 1962 List of Approved Products

THE following additional products have been approved under the Agricultural Chemicals Approval Scheme. The Second List of Approved Products was published on 1st February, 1962.

INSECTICIDES

OXYDEMETON-METHYL

An organo-phosphorus compound related to demeton-methyl, for the control of aphids and red spider mites on top fruit, hops, sugar beet and certain vegetable crops.

Liquid Formulations

Metasystox R—Baywood Chemicals Ltd.

MALATHION—*Dusts*

Malathexo Dust—Pan Britannica Industries Ltd.

HERBICIDES

ATRAZINE

A residual triazine herbicide for the control of annual weeds in maize.

Wettable Powders

Guesaprim—Fisons Pest Control Ltd.

DALAPON WITH 2, 2, 3—TRICHLOROPROPIONIC ACID

A mixture of translocated propionic acid derivatives for the control of emergent water weeds.

Sodium Salt Formulations

Dalacide—Borax Consolidated Ltd.

DICHLORPROP—*Liquid Formulations*

Juvare Dichlorprop WS—Chisholm, Fox and Garner Ltd.

DINOSEB (DNBP)—*Ammonium Salt Formulations*

Asplin's DNBP 13 Selective Weed-killer—Asplin Chemicals Ltd.

DIQUAT SALTS

Dipyridyl formulations specifically for weed control in certain farm and market garden crops before emergence, including bulbs, carrots, kale, peas, potatoes, sugar beet, swedes and turnips.

Liquid Formulations

Preeglone—Plant Protection Ltd.

MCPA—*Potassium and Sodium Salt Formulations*

Southern's MCPA 40—Thos. Southern & Sons, 41 St. Simon Street, Salford 3.
Southern's MCPA 64—Thos. Southern & Sons.

MECOPROP—*Potassium and Sodium Salt Formulations*

Southern's CMPP 51—Thos. Southern & Sons.

SEED DRESSINGS

ORGANO-MERCURY DRY SEED DRESSINGS

Leytosan—F. W. Berk & Co. Ltd.

ORGANO-MERCURY WITH *gamma*-BHC DRY SEED DRESSINGS

Leytosan Combined Seed Dressing—F. W. Berk & Co. Ltd.

In Brief

SWINE FEVER: REGISTERED VACCINATED HERDS SCHEME

The Registered Vaccinated Herds Scheme was revised as from 1st April. The fees for vaccination were increased, and the conditions of the new scheme are more stringent to help achieve a greater degree of protection against infection being carried to a vaccinated herd.

Breeders will now be required to provide isolation premises for newly-bought pigs and to arrange for all pigs to be permanently marked for identification purposes before vaccination. All pigs in the herd must be vaccinated at least once a year, and newly-bought pigs must be isolated for 28 days before being vaccinated and then kept separate from any other pigs for a further 14 days following vaccination. The herds, premises and records of members of the Scheme must be inspected regularly.

The greater degree of protection which the revised Scheme will confer upon Registered Vaccinated herds will be of particular advantage when a slaughter policy for swine fever is introduced, since it may then be possible to consider saving valuable breeding stock in Registered Vaccinated herds which would otherwise have to be slaughtered.

The increased fees which a veterinary surgeon undertaking vaccination may charge a breeder, and which have been agreed between the National Farmer's Union and the British Veterinary Association, are:

A turn-out fee of 12*s.*, plus travelling at 7¾*d.* per mile, and a charge of 2*s.* for each of the first 24 pigs, and 1*s.* 6*d.* for each additional pig vaccinated, together with the cost of the vaccine, which is at present 2*s.* for a small pig and 4*s.* for a large pig.

Breeders participating in the existing Scheme are being invited to join the revised Scheme. Other breeders who are interested in the Scheme should contact the local Divisional Veterinary Officer of the Ministry.

BULK MILK AND THE B.S.I.

The "Drinka pinta milka" slogan has certainly been having heartening effect on sales charts, but the rise in consumption does make the speedy and efficient transport of milk in bulk more essential than ever. The British Standards Institution has published a standard for milk tankers. This standard (B.S. 3441) is designed to rationalize and improve tankers so that users can buy them knowing that they will be reliable, practical, and of known quality.

It will be appreciated that manufacturers who produce tankers complying with the standard will have made considerable efforts to achieve high quality throughout. It is therefore incumbent on the users to ensure that their methods of handling are such that the best results will always be obtained, and that the tankers themselves are properly maintained and correctly worked.

Preparation of the standard was no easy task. The Committee responsible was set up in response to a memorandum from the Society of Dairy Technology early in 1953, by which time there had been a growing demand in the milk industry for the standardization of at least certain features of tankers. This probably arose for two reasons: firstly, the proportion of raw milk transported by tanker in comparison with milk cans had been increasing and, secondly, the balancing of supplies and the centralized control of milk movements generally had led to conditions in which any one milk tanker could draw milk from, or deliver it to, a number of different depots, frequently being operated by different companies.

The standard warns that in order to accommodate a tanker properly and facilitate filling, emptying and the proper measuring of its contents, due attention must be

given to the provision of a permanent level loading and unloading bay at which there should be available all equipment and services required for this purpose.

A range of tank sizes are covered by the standard, together with sections dealing with fittings, thermal insulation and calibration. Very full appendices outline statutory requirements, recommendations for the handling of milk tankers, cleaning and sterilization, agitation of the contents, maintenance and measurement of the milk in the tankers.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1, price 8*s*. 6*d*. each. (Postage will be charged extra to non-subscribers.)

EUROPEAN FARM BUILDING RESEARCH

In January, 1960, a European Documentation Centre for Farm Buildings was set up at Lund, Sweden, under O.E.E.C. (the Organisation for European Economic Co-operation). Its purpose is to collect information on Farm Building Research from certain countries and disseminate it between them periodically by means of newsletters. The countries linked in this way are Austria, Belgium, Denmark, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland and Britain.

At the same time a similar centre was set up at Bari in Italy, linked with France, Greece, Italy, Portugal, Spain, Turkey and Yugoslavia, and the two centres are to exchange the information they collect.

A correspondent to collect and pass on information has been appointed in each country, and the correspondent for Britain is Mr. N. K. Green, of the Ministry of Agriculture, Fisheries and Food, Great Westminster House, Horseferry Road, London, S.W.1.

The newsletters will be issued as a series, with the title *Agricultura Buildings* (repeat *Agricultura*). Nos. 1 and 2 are already available (1½ dollars each or 2 dollars the two) from the European Documentation Centre for Farm Buildings, Statens Forkning-Sanstalt For Lantmannabyggnader, Lund, Sweden, enclosing a Banker's Draft for dollars made payable to Bank Account No. 347–7787 at Sveriges Kreditbank, Lund, Sweden. Interested readers should ask for the English version, because French and German versions are also available.

The first issue deals, among other articles, with heat insulation of floors and grain storage at low temperatures. Newsletter No. 2 contains an account of cowsheds with slatted floors in Norway, results of loose housing investigations in Finland, an article on ventilation of livestock buildings in Denmark, an article on farm buildings in Spain, and summaries of research in European and Mediterranean countries generally.

MORE FAMOUS TREES

Our note in the October issue about the Trafalgar trees of Amesbury has evoked information about similar plantings from a number of readers—in particular, Dr. M. L. Ryder and Mr. K. J. Falkner, both in Australia.

Time sometimes tends to efface interesting pieces of local lore, but our enquiries have established the fact "beyond reasonable doubt" that a group of trees in The Grange at Headingly, Leeds, records the disposition of the troops at the Battle of Waterloo and were indeed planted to commemorate that battle. These trees are thought to have been planted by John Marshall, whose wife was a friend of Dorothy, sister of William Wordsworth.

Similarly, plantings of trees in the grounds of Blenheim Palace, Woodstock in Oxfordshire, show the setting of the Battle of Blenheim. Apparently, Charles, ninth Duke of Marlborough, with his French Architect, Duchêne, set himself to restore the setting of Blenheim as far as possible in accordance with Vanbrugh's

original design. Part of this work included the re-planting in 1902 of the Great Avenue of elms which stretches from the Column of Victory to the Ditchley Gate (3,000 yards), and this is said to represent the lines of the opposing armies.

MANURING OF HAY

Of all the crops grown on the farm grass is often the one most neglected as far as manuring is concerned; yet it is one of the most responsive to generous treatment.

The most important single factor influencing the yield of grass for hay is the supply of nitrogen. This may come from the soil, from organic manures, from fertilizers or from clover in the sward. In experiments it has often been shown that an extra 10 cwt per acre hay can be obtained from 2 cwt per acre sulphate of ammonia containing about 40 units of nitrogen or from 7 tons per acre farmyard manure. A reasonable dressing suitable for most conditions would be 60 units of nitrogen or 10 tons per acre farmyard manure, for, although larger yields may be expected from still heavier dressings, these are outweighed by the extra difficulties of converting the lush grass into hay.

Phosphate and potash are also essential to the growth of hay. Meadows are often well supplied with phosphate, especially if they have frequently received farmyard manure in the past. If this is the case no phosphate fertilizer need be used. On other land 30 units equivalent to $1\frac{1}{2}$ cwt superphosphate will be adequate.

Potash is more important, as hay crops remove 40 to 80 units per acre which in the long run must be replaced. On the average meadow, 60 units or 1 cwt muriate of potash should be used.

In general, if farmyard manure is available it need only be supplemented with a little nitrogen, say 30 units. On unmanured land, either 4 cwt per acre 16 : 0 : 16 compound fertilizer if the soil is well supplied with phosphate, or 5 to 6 cwt per acre 10 : 10 : 15 compound fertilizer for general use, should ensure good crops.

PENNINE FARM

Progress on Pennine Farm is the title of a new film produced by I.C.I. The location is Mr. Oliver Barraclough's 85-acre dairy farm outside Bradford, and its story is the comparison of today's methods with those of five years ago. Practically the whole of the farm is in grass, mainly leys, based on a well-considered fertilizer policy, to give a feeding programme of grazing and self-fed silage plus a minimum of concentrates.

The contrast of 1961 and 1956 operations is well brought out in the film by showing the former in colour and the latter in black and white. Sixty-five cows are giving a total production of 52,394 gallons, and the fertilizer cost is £9 per acre.

The film (running time 30 minutes) is available from I.C.I. Film Library, Imperial Chemical Industries House, Millbank, London, S.W.1.

FORESTRY COMMISSION: NEW DIRECTOR GENERAL

Sir Henry Beresford-Peirse, Bt., C.B., has been appointed Director General of the Forestry Commission as from 1st April. Sir Henry, who has been Deputy Director General for the past nine years, joined the Commission in 1929 and was Director of Forestry for Scotland from 1947 to 1953. For the past two years he has been seconded to the Forestry Division of FAO in Rome.

Sir Henry succeeds Sir Arthur Gosling, who has been Director General since 1948 and is retiring after more than 40 years with the Commission.

Book Reviews

Farm Planning and Management. C. H. BLAGBURN. Longmans Green. 45*s*.

The author hopes that this book will be of use not only to the progressive farmer but also to the agricultural advisory worker and the student. It certainly will, although it is to students (or their lecturers) that it will have its greatest appeal. In its 350 pages of text many of the reports on farm economics published in recent years have been quoted, and students will find it a valuable source of information on many aspects of farm planning and management.

Part I discusses the general analysis and planning of a farm business. On these topics the author is on his home ground, since he developed what has become known as the "Blagburn Method" of farm business analysis, and he gives a clear and concise exposition of the calculations needed and their value in assessing any management weaknesses. In the budgeting section, mention is made of the more recent developments of programme planning and the preparation of gross margins for individual enterprises. Some further discussion of these developments would have been of use, both to students in the 1960's and to those farmers and advisers who favour this approach to their management problems rather than the more abstract methods developed in the early 1950's.

Parts II and III contain reference material of particular interest to the student. The economic use of each of the main resources used on a farm—feeding-stuffs and forage crops, labour, machinery and capital—is discussed in turn. Then each of the main farm enterprises—dairying, cattle and sheep, arable crops, etc.—is examined in detail. Many of the financial illustrations, quoted from published university reports, may become rapidly out of date as guides to current costs and returns. But the reasoning in these chapters gets to the crux of the factors which determine the profitability of each enterprise. Consequently, the observations and conclusions in each section will remain of great value long after the illustrations are out of date.

Part IV—the farmer's markets—contains some useful chapters not usually found in text books on farm management. The purpose of the chapters is to describe as concisely as possible the existing price arrangements for farm produce and where possible to draw conclusions as to their effects on economic farm management. Some of the farmer's management decisions, e.g., the season of production and the quality of the product, may vitally affect the prices received. It is, therefore, important to have a good understanding of current marketing arrangements.

The final part of the book discusses the records needed to run a farm business successfully. Many farmers would undoubtedly benefit from more detailed records, and Blagburn describes some which may be of use. But he warns against the indiscriminate keeping of elaborate records. "Unless a record form or book will help to show the farmer where the operation of a particular enterprise is defective, or where the organisation of the farm as a whole can be improved, it had better be avoided." Some of his own records, however, may be too elaborate and involved for the majority of farmers who have neither the time nor the inclination for much record-keeping.

All in all, although this book is not the definitive work on the subject, it does provide a most useful compendium of facts and ideas for student and farmer alike.

K.D.

Malta: Background for Development. H. BOWEN-JONES, J. C. DEWDNEY AND W. B. FISHER. Department of Geography, University of Durham. 42*s*.

Although Malta is only the area of the Isle of Wight, British advisers to the Department of Agriculture and the State Dairy have in the past been handicapped by a lack of basic knowledge about the island's soil, the details of land utilization, the distribution of agricultural production and the inter-relationship of these factors. They were therefore pleased to associate with the Maltese Government and the Colonial Office in giving Durham University facilities to carry out this study of the Maltese Islands.

The resultant book deals with constitutional and historical matters, population and migration, trade and social affairs, but

is concerned mostly with the physical characteristics of the land, climate and agriculture, and this review is confined to the last-mentioned items.

Maltese agriculture is restricted mainly by poor soil conditions and insufficient fresh water. Rainfall is restricted to the winter months. An economical method of increasing water supplies is a paramount need. The book brings out well the conflict between the agricultural and non-agricultural (domestic and industrial) use of water.

A general classification of the soil is given, with a map showing the distribution of the main types, but as the authors recognize, much more soil analysis and experimental work are necessary to discover the appropriate treatment to secure the highest fertility in relation to the crops grown and their rotation.

The authors provide much useful geological and hydrographical information which will be invaluable to the government and to extension advisers.

Their chapter on farm holdings gives a fair appreciation of a problem that will have to be tackled. Many farms are too small to be economic: the problem is complicated by sociological factors and geographical difficulties relating to terraced lands. More consideration might have been devoted to rearing of livestock, especially to the dairy herd and the cow/goat controversy. This problem is stated rather than dealt with. It is a complex matter involving economics, feeding, disease and the apparent consumer preference for goat's milk.

The book is well illustrated with maps, tables and photographs and has a useful index. It will interest geographers, sociologists and agriculturists, whether or not they have acquaintance with Malta.

G.W.F.

Fundamentals of Nutrition. E. W. CRAMPTON and L. E. LLOYD. W. H. Freeman and Co. 50*s*.

The aim of this book, say the authors, is "to introduce to students an integrated picture of the field of nutrition and to illustrate the type of facts and figures with which the nutritionist must deal". It can be divided broadly into three sections: the first part concerns the major groups of nutrients, protein, fat, carbohydrate, minerals and vitamins, and their metabolism in the body. The pathways of intermediate metabolism are given in detail and illustrated with clear, concise diagrams.

The following chapters concern some of the quantitative aspects of nutrition, the sampling and selection of animals for experiments, the principles of feeding trials, and the determination of the digestibility of diets. Heredity and the use of statistics in the interpretation of experimental results are also considered. For an introduction to nutrition the information is detailed and will be of greatest use to those directly concerned with animal feeding experiments.

The final chapters deal particularly with the energy and protein requirements of animals and man, and the increased nutrient intakes demanded by growth, pregnancy and lactation. Tables of recommended allowances are given and their limitations discussed.

For students of human nutrition there is no detailed consideration of the composition of foods, the use of food tables, or the bacteriological aspects, and there is only a brief mention of appetite, malnutrition and starvation. Throughout, nutrition is considered in strict biochemical and physiological terms rather than in a wider context covering diet and food composition.

E.B.

Down the Long Wind. GARTH CHRISTIAN. Newnes. 21*s*.

Mr. Christian has written a fascinating book, whether or not one happens to be interested in bird migration, the problems which it involves and the ingenious ways in which these are being investigated nowadays. In the last few years great advances have been made, so great that much of what passed for truth before is now sadly out of date. A long series of experiments has been carried out on homing and day-time navigation, chiefly with shearwaters and pigeons. Two Swiss scientists used a planetarium to find out how night migrants navigate, and Kenneth Williamson has made special studies of migrational drift.

Bird Observatories, both at home and abroad, have added a great deal to the fast-accumulating store of information, and the tracking by radar of migrating birds has opened new, wide avenues of research. The results of all these—and many other—recent studies, often highly technical, have been published in specialized books and journals, but very few popular digests for the general reader have yet seen the light of day.

The first, and most valuable, half of *Down the Long Wind* is concerned with this omission. Indeed, the author's outstanding gift is his ability to assimilate and compress the gist of learned treatises and scientific data into a few simple paragraphs that anyone could understand—and that is no mean feat. He traces, too, the tale of human speculation upon migration, from the ancient Greeks to the score or more Bird Observatories operating in Britain today, to say nothing of those in Europe, the United States and elsewhere. He contrasts past and present theories—even Gilbert White half-believed that swallows hibernated, like frogs, in the bottom mud of ponds—and cites instances in plenty (largely from Observatory reports) of all he writes about.

In later chapters he deals mainly with migrations of individual species: swifts, tit and crossbill invasions, nightjars, cuckoos and so forth, incorporating his personal experiences with the pooled observations of experts, gleaned widely from the literature on the subject: an apt but difficult selection that leads occasionally to such curious mis-statements as "almost the whole world's population of yellow wagtails breeds in Britain"! (p. 159.) Nevertheless he strongly makes the point that birds and their ways are part of a natural heritage we cannot live fully without.

Aubrey Buxton contributes an excellent foreword; and the book is illustrated by many maps and attractive photographs, most of them by Eric Hosking.

E.A.R.E.

Modern Poultry Husbandry (5th Edition). LEONARD ROBINSON. Crosby, Lockwood. 42*s*.

Mr. Robinson's book is well known as the best single, comprehensive poultry book written in this country. There is not one phase of the industry that does not receive attention. It is a book that can be, and generally is, recommended to those who are contemplating poultry farming and are seeking general advice. This 5th edition, coming four years after the last one, has been extensively brought up to date, particularly in respect of new developments, statistics and economic data. It is a great credit to the author and his publishers that such frequent revision has been made since the work first appeared in 1948. Only by so doing can the newcomer be put in the picture. The production is first-class and the book is easy to read in every way.

W.M.A.

Diseases and Pests of Ornamental Plants (3rd Edition). P. P. PIRONE, B. O. DODGE and H. W. RICKETT. Constable. 84*s*.

The fact that a third edition of this large book has been brought out in seven years is a fair indication of its popularity in the United States. It is divided into two sections, the first of which reviews the various causes of damage in plants giving general descriptions of disease organisms and insect pests. Also included is an account of modern control methods in which chemical control is dealt with in a rather brief and incomplete fashion.

In the main section some 500 ornamental plants are arranged alphabetically by their scientific names. Under each heading there is a list of the pests, diseases and physiological disorders affecting that plant, together with the appropriate control measures. It is a very wide range to cover in a single book and the descriptions of damage are necessarily terse, but, in some cases, they are much too meagre. As this is essentially a reference book for the identification of plant troubles, it would also have been more useful if some time had been spent in arranging pests, diseases, etc., in alphabetical or taxonomic order.

This edition is larger than the previous ones and has more illustrations, the majority of which are of a high standard. It contains much useful and up-to-date information and would prove a handy addition to the library of the advisory plant pathologist or entomologist.

D.E.G. and *P.B.*

Economic Plant Diseases of Scotland (Department of Agriculture and Fisheries for Scotland Technical Bulletin No. 1). C. E. FOISTER. H.M. Stationery Office, Edinburgh. 10*s*. (10*s*. 9*d*. by post).

This is a most careful and thorough account of the fungi, bacteria, viruses and non-parasitic agents which have been recorded on Scottish crop plants. Part II is a complete list of them, conveniently arranged in alphabetical order of the scientific names of both host plants and parasites. Eelworm diseases are not listed but are to be included in a later zoological list. Common names are included, and for non-parasitic kinds of damage, such as mineral deficiencies and the toxic action of chemicals, etc., remarkably concise descriptions of symptoms are given where there is no common name. This succinct

information alone occupies 73 pages, which might give the impression that Scotland has more than its share of crop disease. Such is not the case, however, and Part I restores the balance. It describes the general pattern of Scottish agriculture and assesses the distribution and economic significance of the commoner maladies, with discussion of their relative importance from year to year. This section also includes a most useful, readable and welcome account (to 1958) of all the plant pathological investigation which has been going on patiently north of the border. Dr. Foister has here presented an account of real progress, made it thrilling and human, brought the story together for the first time, and made of it a dignified whole.

The first urge to write the bulletin was to provide a work of reference for advisory officers in Britain. But since the International Plant Protection Convention of 1951 a wider obligation to the Food and Agriculture Organisation of the United Nations has emerged, namely, a world reporting service by signatory countries on diseases of economic plants. The bulletin fulfils these two requirements and contributes to both an appendix and tables to show the standards and progress of Scottish certification schemes. It should, however, evoke an even wider interest in research institutes, teaching departments and among the increasing number of practical growers who recognize the contribution that scientific services can render to the art, craft and business of growing crops. *J.G.*

The Daffodil and Tulip Year Book, 1962. The Royal Horticultural Society. 12*s*. 6*d*.

Continuing their now well-established series of Daffodil and Tulip Year Books, The Royal Horticultural Society present another useful volume for 1962. The value of the series for reference purposes is increased by the inclusion of a ten-year index. So wide is the range of subjects already covered that it might be thought that few are left, yet the future is a theme running through several articles in the present volume. Mr. Jefferson-Brown comments on the near-perfection of many of the leading show daffodils and draws attention to the possibility of an increase in popularity of the smaller, informal varieties, the pink and green-eyed flowers.

Similarly with tulips, an article from U.S.S.R. describes new species from Central Asia, which, in addition to their botanical interest, will probably influence future developments, while Mr. Bram Warnaar outlines current work with tulips in the Netherlands, such as new colour breaks in the Darwin hybrids, the *fosteriana* and *greigii* families.

A commendable proportion of space is allotted to commercial interests, covering bulb forcing under artificial light and the results of experimental work at Rosewarne and Kirton Experimental Horticulture Stations. Fertilizer use, methods of planting, chemical weed control and the place of mobile glasshouses are among the lines of development here. An extract from the records of the valuable 600-variety daffodil collection at Rosewarne lists varieties most prolific in flower and bulb production. It is disappointing how few modern show varieties qualify for inclusion.

Highlights for the show bench remain, however, a preoccupation for many—probably the majority—of readers. Pride of place is justly given to an account of fifty years of daffodil breeding by J. L. Richardson and the story of some of his outstanding achievements. His recent death, further diminishing the already sadly-thinned ranks of daffodil breeders, suggests that we are at the end of an epoch. Nevertheless accounts of the numerous daffodil shows in this and other countries indicate that interest is unabated; the standard of reporting has much improved in recent years. The contribution by Mr. Alec Gray is certainly a model for readableness and interest, deftly spiced with criticisms which are both kind and constructive.

The illustrations include some exceptionally beautiful flower portraits by J. E. Downward, a reminder of his well-deserved recognition by the Society for his work in this field. *K.H.J.*

Dictionary of Agricultural Engineering. H. J. Hine. Heffer. 15*s*.

Such a wealth of useful information has been gathered into this little book that it is sure to find a place, ready to hand, on very many bookshelves—and, not infrequently, carried around in the pocket.

Many reference books on agriculture and engineering have been produced, but this is one of the first on agricultural engineering. The author's main problem must have

been to determine what to include and what to leave out. Although it is difficult to judge by what criteria his choice was made, the final result will surely cater for a very wide public.

The novel idea of including, where applicable, notes on the evolution and historical background of machines and processes is welcome. A human element is introduced; the driving force behind progress in farm mechanization. The translation of many of the alphabetically arranged headings into French and German gives an international touch, which is all to the good.

There could be as many critics of the book's content as there are readers. Personally, I had the impression that treatment in some instances is a little illogical. I couldn't understand why, for example, an item Kinetic Energy is included in isolation. Why not just energy, and include with kinetic energy its counterpart, potential energy? And if Energy is to be included, why not Acceleration, an even more fundamental property of matter?

The formulae given in the section "Weight on Drying" are not as clear as they might be. On the other hand, the generous use of tables throughout the book is to be commended.

The dictionary will be welcomed by engineers and farmers, but it is possible that the appeal to the student will be the greater, for quite certainly material for answering very many stock examination questions is to be found within the book's 252 pages. No less, the lecturer, called upon to prepare talks and schemes for various types of student, and the instructor in manual crafts, are bound to find this book very useful indeed. *F.C.R.*

A Standard Account for Landed Property Investment. Estates Gazette. 6*s*. 6*d*.

The ownership of rural estates has never succumbed to the methods of big business. As a consequence, although there is a vast amount of wealth tied up in such ownership, we know precious little of the capital movement involved or of capital formation.

The Chartered Land Agents' Society are pioneering a method of accounting aimed at correcting this deficiency and owners who care to adopt the method will over the years build up a financial story about their estate the like of which probably does not exist today.

For the owner whose main object is the pleasure his estate can give, the method may have no appeal, but to the business-man owner and institutional owner it ought to be attractive. Although mainly for owners of sizeable estates, the large farming enterprises which own their land could use the system with advantage—and perhaps some surprises for owner-occupiers who notoriously ignore the true cost of fixed capital.

This little booklet breaks new ground and, though not easily followed, does contain a worthwhile idea. *C.R.*

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MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

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